9 Postoperative/Posttraumatic Changes

Fat Necrosis

Synonyms: liponecrosis microcystica calcificata.

Fat necrosis is a localized area of dead adipose tissue characterized by morphological changes resulting from progressive enzymatic degradation. Leukocytic and histiocytic infiltrates are encountered in new areas of fat necrosis. Gradually, well-vascularized granulation tissue develops. The transformation into scar tissue is usually complete in a matter of weeks. The coalescence of liquefied adipose tissue can lead to formation of so-called *oil cysts*.

! A fresh fat necrosis can be very difficult to differentiate from breast cancer, i.e., breast cancer recurrence in breast MRI, as well as in mammography and breast ultrasound.

MR Mammography: Fat Necrosis

T1-Weighted Sequence (Precontrast)

Signal intensity equivalent to that of parenchyma (**Fig. 9.1b**). *Oil cysts* present as rounded lesions with a hyperintense (fat-equivalent) signal (**Figs. 9.2b, 9.3b**). Possible signal loss due to macrocalcifications (**Figs. 9.4b, 9.5a**).

T2-Weighted Sequence

A fresh fat necrosis presents as an ill-defined, hyperintense area (**Fig. 9.1c**). Later, when oil cysts are present, round lesions with central, fat-equivalent signal intensity are seen (signal-free in IR T2w sequence due to fat suppression) (**Figs. 9.3c, 9.4c**). Otherwise no characteristic changes after 6 months.

T1-Weighted Sequence (Contrast Enhanced)

In the early phase when capillary sprouting takes place (first 6 months after trauma/surgery), fat necrosis presents as a localized, sometimes well-defined (**Fig. 9.1a, d**), but usually ill-defined (**Fig. 9.2a, d**) area with increased CM uptake (**Fig. 9.1a, d**). Initial signal enhancement is usually moderate (**Fig. 9.1e**). The postinitial signal increase is typically persistent or displays a plateau. In the late phase (>6 months) there is usually no more contrast enhancement (**Figs. 9.3a, d, 9.5b**). Mild enhancement may be seen when there is an additional inflammatory component (**Fig. 9.4d**).

Fat necrosis: General information	
Etiology:	Posttraumatic (e.g., injury, surgery, needle biopsy), inflammation, foreign body reaction (e.g., silicone, paraffin).
Risk of malignant transformation:	No increased risk.
Findings	
Clinical:	Usually occult. Large findings may present as a mass or thickening.
Mammography:	Round, oval, or irregular mass lesion. Homogeneous and hyperdense. No specific findings. New fat necrosis: ill-defined area of increased density. Older fat necrosis: improving demarcation of density. Oil cysts: rounded, centrally radiolucent lesions possibly containing bizarre or rim calcifications.
Ultrasonography:	Great variability: from round, well-defined lesions to irregularly shaped lesions showing echo texture typical of malignancy.

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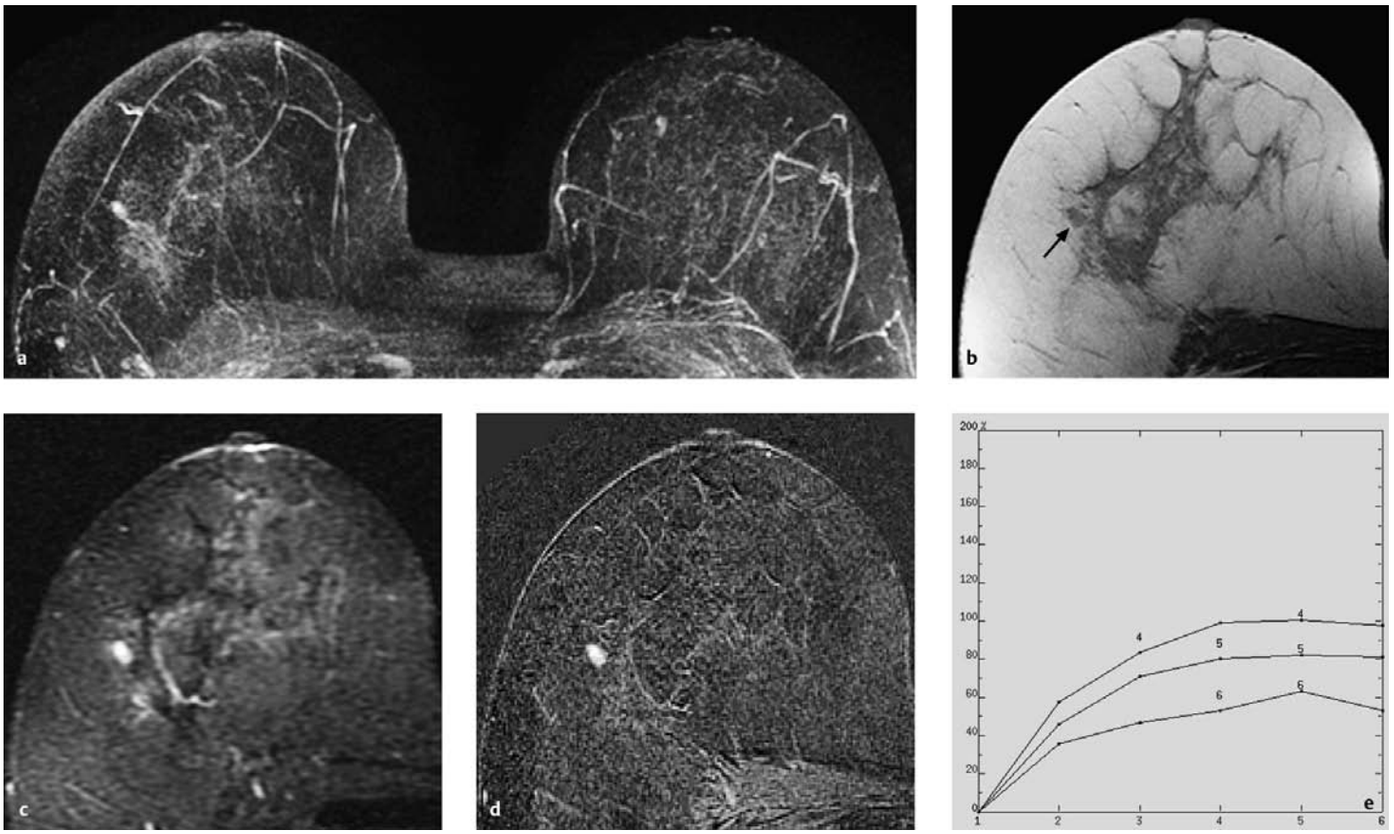


Fig. 9.1a–e Fresh fat necrosis.

a Subtraction MIP: oval, hypervascularized focus in the lateral aspect of the right breast.

b T1w precontrast slice image: corresponding oval focus (4 mm, arrow) within the lipomatous breast tissue lateral to the parenchymal body.

c IR T2w slice image: lesion displays a high signal intensity, i.e., water content.

d Early subtraction slice image: strong contrast enhancement.

e Unspecific TIC.

Percutaneous biopsy-proven diagnosis.

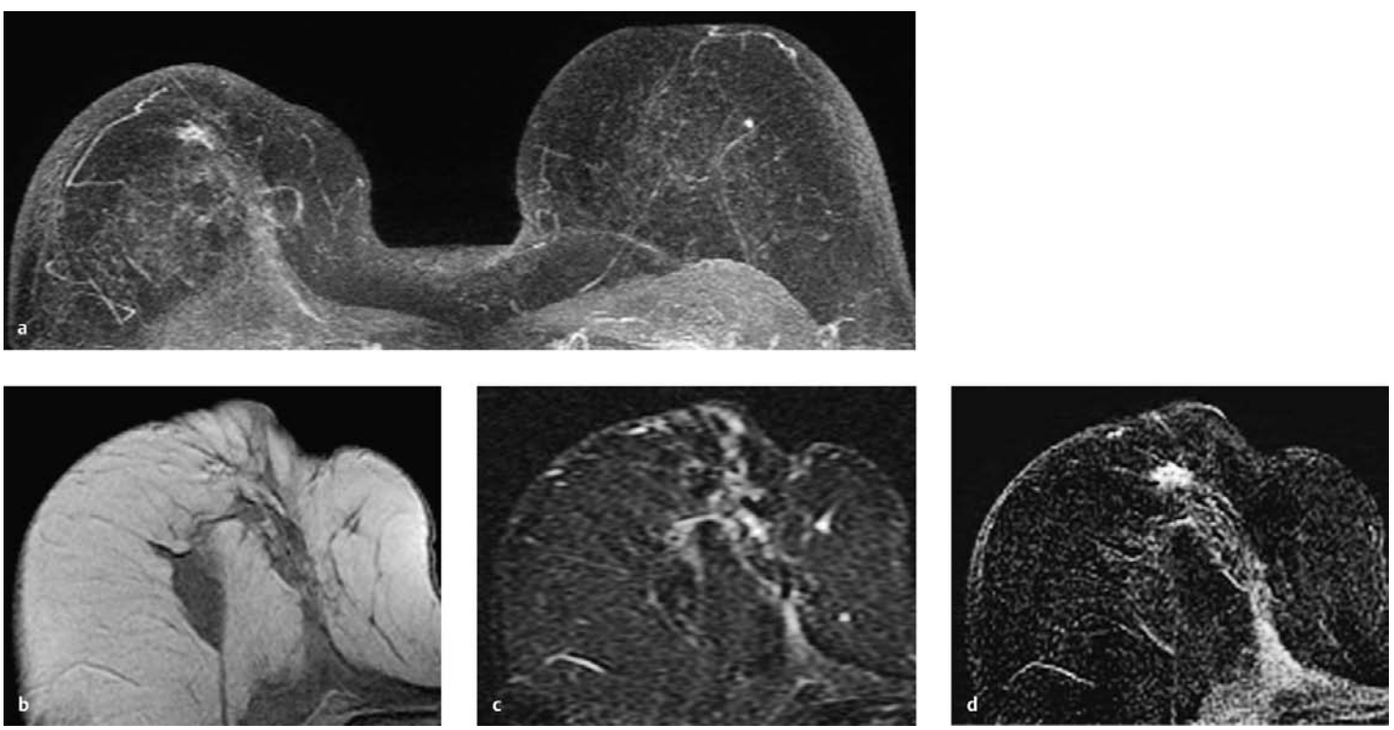


Fig. 9.2a–d Fat necrosis: several weeks after surgery.

a Subtraction MIP: irregular, hypervascularized lesion in the scar tissue area of the right breast, 8 weeks after breast-conserving therapy.

b T1w precontrast slice image: morphologic distortion in the right breast due to scar tissue. Slight signal increase in fat necrosis.

c IR T2w slice image (fat saturated): mild reactive edematous changes in scar tissue area.

d Early subtraction slice image: rim-enhancement around discrete central liquid inclusions.

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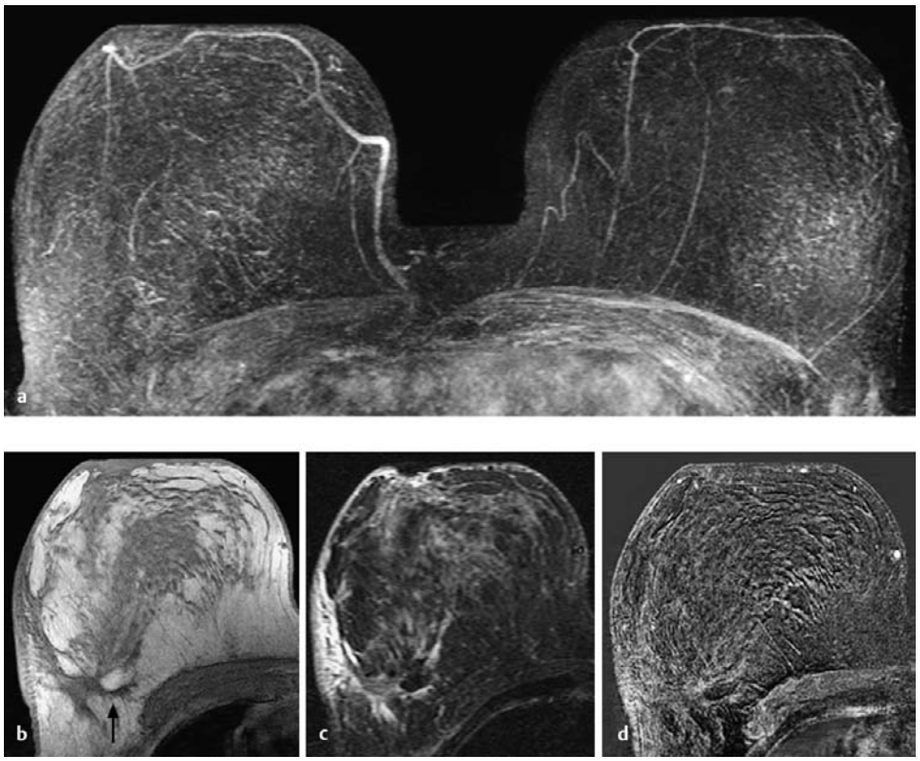


Fig. 9.3a–d Old fat necrosis.
a Subtraction MIP: unremarkable findings 2 years after breast-conserving therapy.
b T1w precontrast slice image: localized area of scar tissue with oval, fat-containing area (arrow). Skin thickening.
c IR T2w slice image (fat saturated): reactive edematous changes of cutaneous and subcutaneous areas after radiation therapy. Complete signal suppression of oval fat necrosis.
d Early subtraction slice image: fat necrosis displays no contrast enhancement.

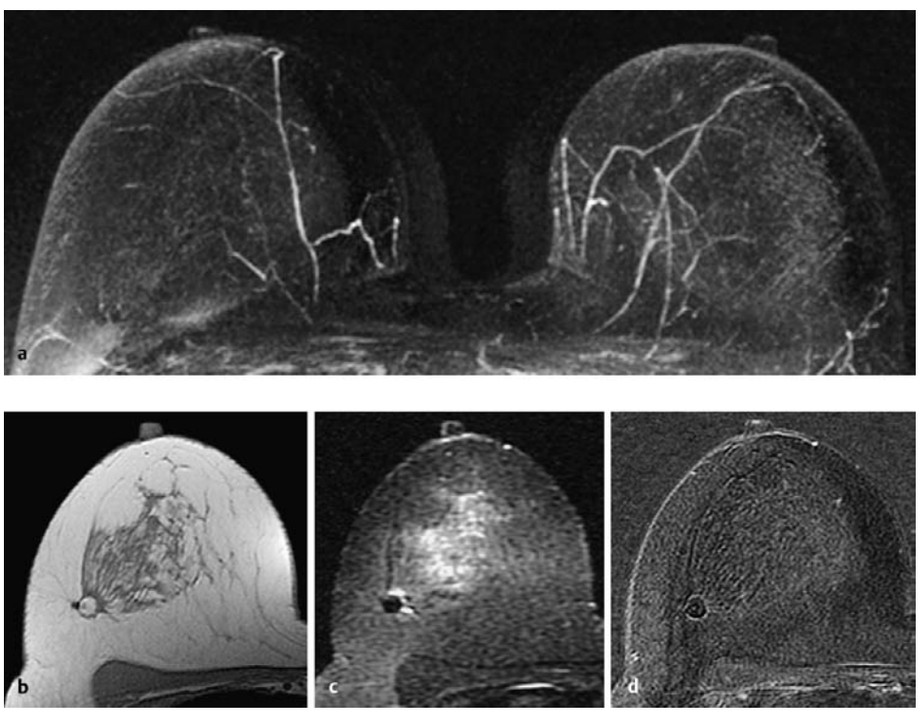


Fig. 9.4a–d Oil cyst.
a Subtraction MIP: unremarkable findings several years after diagnostic excision.
b T1w precontrast slice image: round lesion with fat-equivalent internal signal and peripheral punctate signal extinction due to calcification.
c IR T2w slice image (fat saturated): mildly elevated signal intensity (water content) of parenchyma. Signal suppression of the lesion's internal liquefied fat.
d Early subtraction slice image: very discrete rim-enhancement.

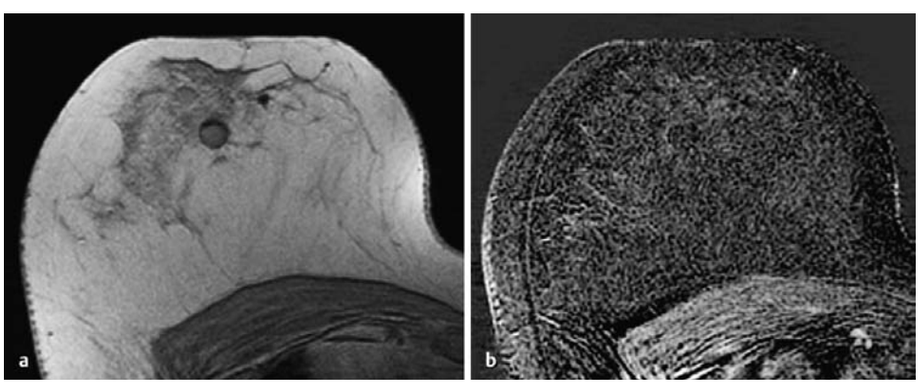


Fig. 9.5a, b Oil cyst.
a T1w precontrast slice image: round oil cyst with slightly elevated internal signal and peripheral signal extinction due to calcification.
b Early subtraction slice image: fat necrosis displays no contrast enhancement.

Seroma

A seroma is a localized collection of wound serum in the tissues, for example after surgery.

MR Mammography: Seroma

T1-Weighted Sequence (Precontrast)
More or less circumscribed area usually demonstrating a slightly hypointense signal in comparison with surrounding parenchyma (**Fig. 9.7a**). Occasionally cushionlike or villuslike internal structures along or stemming from internal seroma wall (**Fig. 9.6a**).

T2-Weighted Sequence
Hyperintense fluid within seroma (**Figs. 9.6b, 9.7b**).

T1-Weighted Sequence (Contrast Enhanced)
Immediately after surgery CM uptake is usually slight, after several days it is stronger in areas immediately surrounding the seroma (**Figs. 9.6c, 9.7c**).

Seroma: General information	
Age peak:	No age dependence. Postoperative.
Risk of malignant transformation:	No increased risk.
Findings	
Clinical:	Small seromas are clinically occult. Large findings may present as an elastic mass.
Mammography:	Seromas within dense parenchymal areas are often mammographically occult. Within lipomatous areas: round, hyperdense mass.
Ultrasonography:	Well-circumscribed, liquid-filled mass (similar to a cyst). Occasionally villuslike, noncystic internal structures on the seroma wall.
Seroma is a frequent postoperative finding without major clinical significance. Large seromas may be an indication for fine-needle aspiration.	

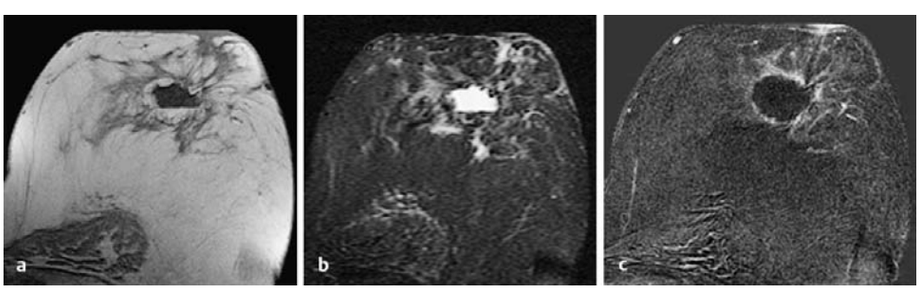


Fig. 9.6a–c Postoperative seroma.
a T1w precontrast slice image: round lesion with surrounding capsule and polypous structures adhering to the internal wall.
b IR T2w slice image: high signal intensity (water content) within the seroma.
c Early subtraction slice image: discrete enhancement of seroma wall. Polypous structures display no perfusion.

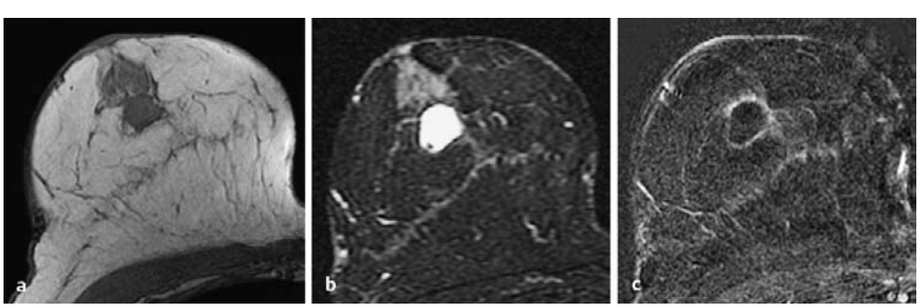


Fig. 9.7a–c Postoperative seroma.
a T1w precontrast slice image: lobulated, hypointense lesion with surrounding capsule.
b IR T2w slice image: high signal intensity (water content) within the seroma.
c Early subtraction slice image: discrete enhancement of seroma wall.

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Hematoma

A breast hematoma is an intramammary hemorrhage, for example, due to intervention or surgery.

MR Mammography: Hematoma

T1-Weighted Sequence (Precontrast)

A hematoma shows a typical signal intensity, as in other regions of the body, depending on the time elapsed since its development. A fresh hemorrhage demonstrates a homogeneous high signal intensity (**Fig. 9.8**). A subacute hematoma shows a low internal signal with a hyperintense peripheral ring (**Fig. 9.9**). An old hematoma may be hyperintense (**Fig. 9.10a**).

T2-Weighted Sequence

A fresh hematoma displays a homogeneous low signal intensity. With increasing age, a hypointense peripheral ring develops (**Fig. 9.10b**).

T1-Weighted Sequence (Contrast Enhanced)

Diffuse reactive CM uptake occurs in the parenchyma surrounding a subacute hematoma. With increasing age, the reactive changes decrease and usually disappear completely (**Fig. 9.10c**).

Hematoma: General information	
Incidence:	Often after intervention. Occasionally after surgery. Rare after other trauma.
Risk of malignant transformation:	No increased risk.
Findings	
Clinical:	Small hematomas are clinically occult. Large findings may present as a palpable mass. Later visible skin pigmentation.
Mammography:	Hematomas within dense parenchymal areas are often mammographically occult. Within lipomatous areas: round, hyperdense mass.
Ultrasonography:	Well-circumscribed, hypoechoic structure.
Incidental finding without major clinical significance. Large hematomas may be an indication for fine-needle aspiration.	

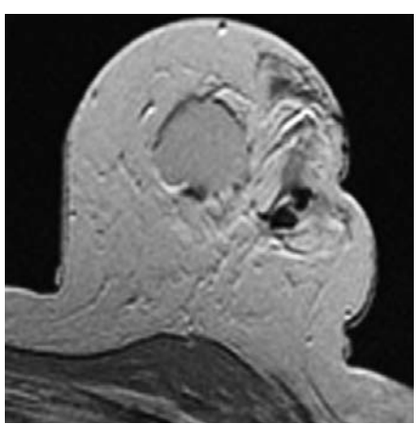


Fig. 9.8 Acute hematoma. Hyperintense, fat-equivalent lesion in the T1w precontrast image immediately after percutaneous vacuum-assisted biopsy.

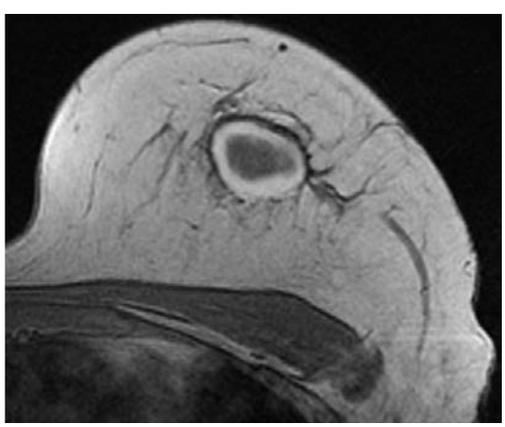


Fig. 9.9 Subacute hematoma. Same patient as in **Fig. 9.8**, several days later. Hyperintense rim in the peripheral areas of the hematoma due to hemosiderin precipitation and lower signal intensity in the center of the hematoma (T1w precontrast image).

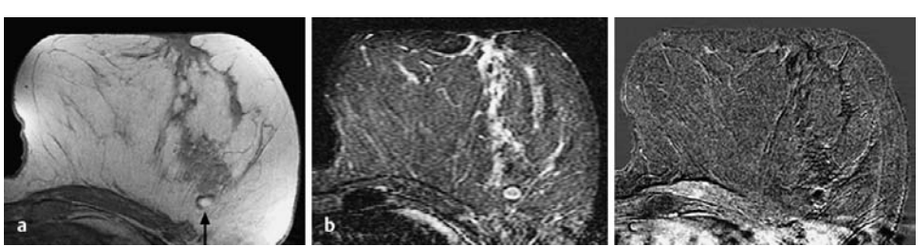


Fig. 9.10a–c Old hematoma. Breast MRI 6 months after percutaneous vacuum-assisted biopsy.

- **a** T1w precontrast slice image: small hematoma with high central signal intensity and hypointense rim.
- **b** IR T2w slice image: opposite signal intensities (low central signal intensity and hyperintense rim).
- **c** Early subtraction slice image: no enhancement.

Scar Tissue

In the course of wound healing, scar tissue develops from granulation tissue ~3 to 6 months after tissue injury (e.g., vacuum-assisted biopsy, surgery, trauma). Scar tissue is then mostly composed of collagen with a smaller amount of cells and blood vessels.

! The absence of contrast enhancement in an area of scar tissue rules out a recurrence/breast cancer with high reliability. Not every contrast enhancement in an area of scar tissue, however, is proof of a recurrence or breast cancer.

MR Mammography: Scar Tissue

T1-Weighted Sequence (Precontrast)
Hypointense, usually ill-defined or stellate finding (**Figs. 9.11a, 9.12a, 9.13a**). More difficult to detect when located within parenchyma (**Figs. 9.14b, 9.15b**). If located within lipomatous tissue, identification as high contrast stellate lesion. Often associated with susceptibility artifacts due to cauterization during surgery (**Figs. 9.11a, 9.13a**).

T2-Weighted Sequence
Variable, unspecific findings with a low (**Fig. 9.12b**) or increased water content (**Figs. 9.14c, 9.15c**) in the scar tissue area.

T1-Weighted Sequence (Contrast Enhanced)
Ideally there is no contrast enhancement in a scar tissue area (**Figs. 9.11b, 9.12c**). Occasionally enhancement in a scar tissue area can last over 6 months (**Fig. 9.16b–e**), for example as focal or diffuse enhancement in the case of prolonged wound healing, or as a regional enhancement in the case of localized granulomatous-inflammatory changes (**Figs. 9.13b, 9.14a, d, 9.15a, d**). In these cases the differential diagnosis between scar tissue and a recurrence or cancer of other etiology is difficult. The time–signal intensity curves (TICs) are uninformative (**Fig. 9.15e**).

Scar tissue: General information	
Incidence:	After surgery.
Risk of malignant transformation:	No increased risk.
Findings	
Clinical:	Small scars and those deep within the parenchyma are clinically occult. Large scars and/or those near the skin may present as a palpable hardening. Possible skin retraction.
Mammography:	Architectural distortion or irregular/spiculated mass. May initially be associated with microcalcifications. Later macrocalcifications represent regressive changes.
Ultrasonography:	Irregular or spiculated, hypoechoic structure, often displaying dorsal acoustic shadowing. No flow phenomena in the CCDS.
A postoperative scar is difficult to differentiate from malignancy using morphologic criteria (mammography, ultrasonography).	

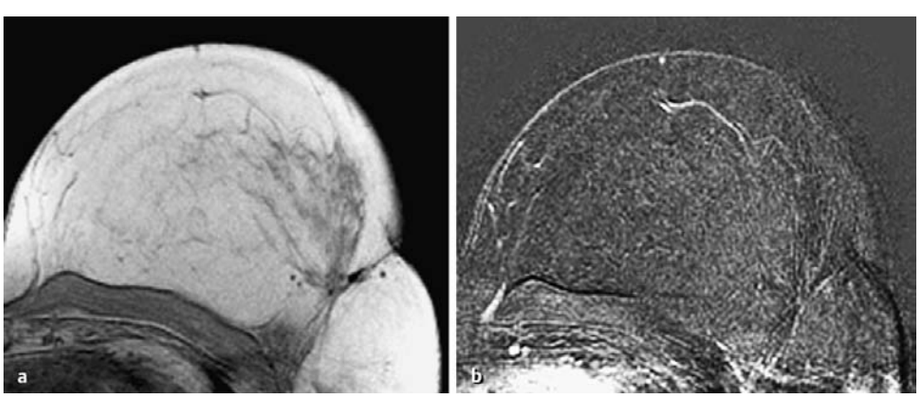


Fig. 9.11a, b Typical findings of a postoperative scar.
a T1w precontrast slice image (left breast): architectural distortion and susceptibility artifacts.
b Early subtraction slice image (left breast): no enhancement in entire scar area.

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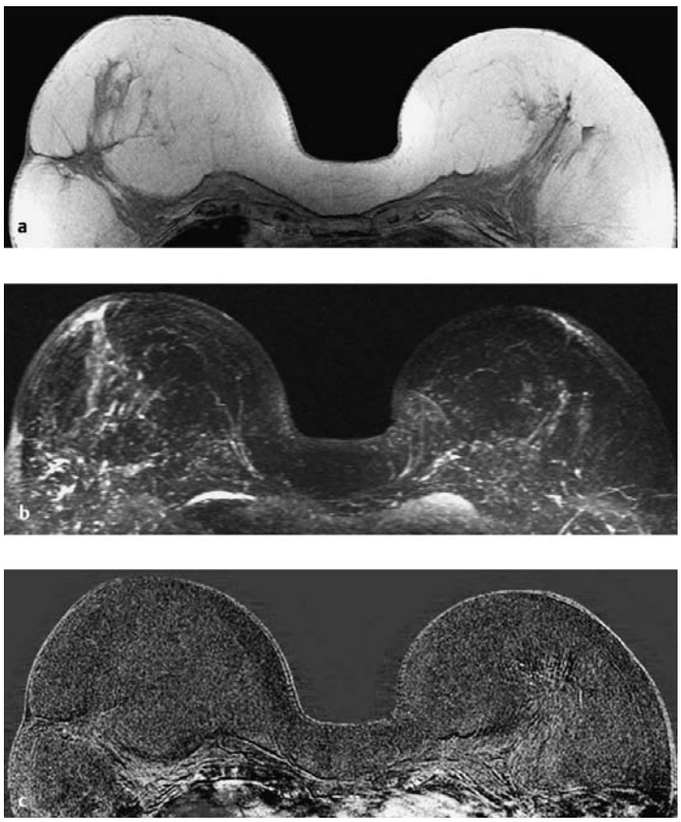


Fig. 9.12a–c Typical findings: bilateral postoperative scars.
a T1w precontrast slice image: bilateral scar structures after bilateral breast-conserving therapy.
b IR T2w slice image: discrete edematous changes in both breasts after radiotherapy.
c Early subtraction slice image: no enhancement in both scar areas.

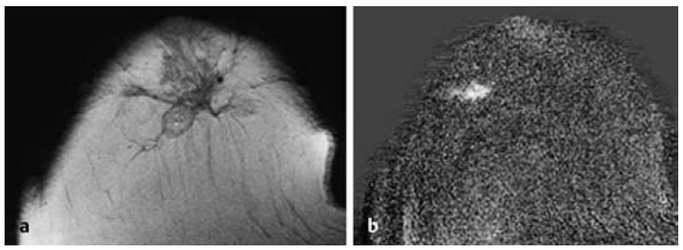


Fig. 9.13a, b Postoperative scar with mild inflammatory component.
a T1w precontrast slice image: architectural distortion and susceptibility artifacts after breast-conserving therapy.
b Early subtraction slice image: localized enhancement in the lateral aspect of the surgical scar area.

Histology after vacuum-assisted biopsy: scar tissue with mild granulomatous inflammation.

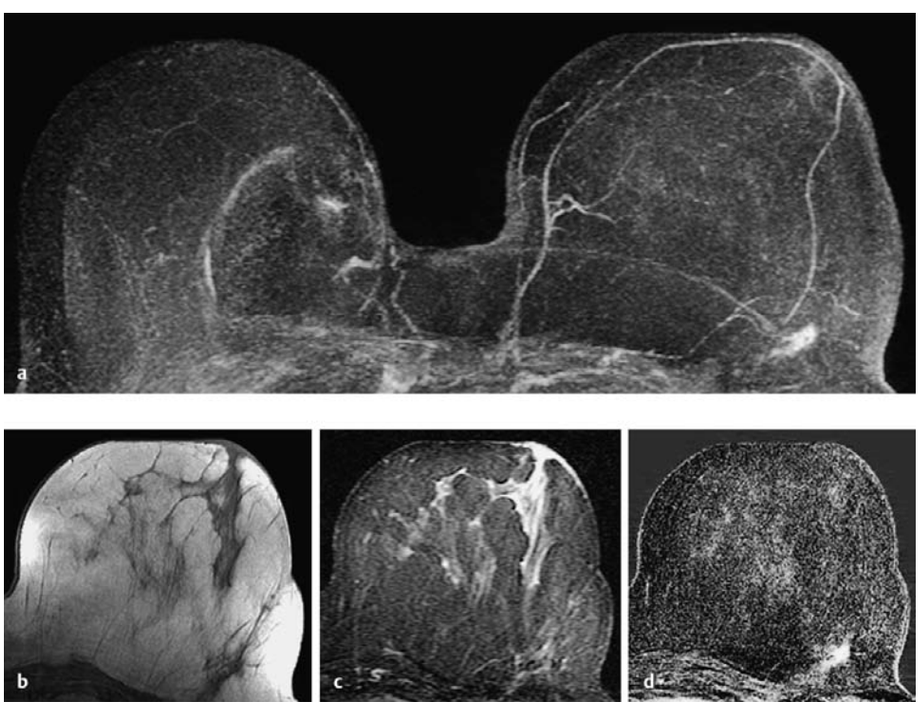


Fig. 9.14a–d Postoperative scar with significant inflammatory component. Breast-conserving therapy of the left breast 4 years before examination.
a Subtraction MIP: localized enhancement in the scar area in the lateral aspect of the left breast.
b T1w precontrast slice image (left breast): typical structural changes associated with a scar area.
c IR T2w slice image (left breast): very discrete increased water content in the scar area.
d Early subtraction slice image (left breast): regional enhancement in the center of the scar area.

Histology after vacuum-assisted biopsy: granulomatous mastitis in scar tissue area.

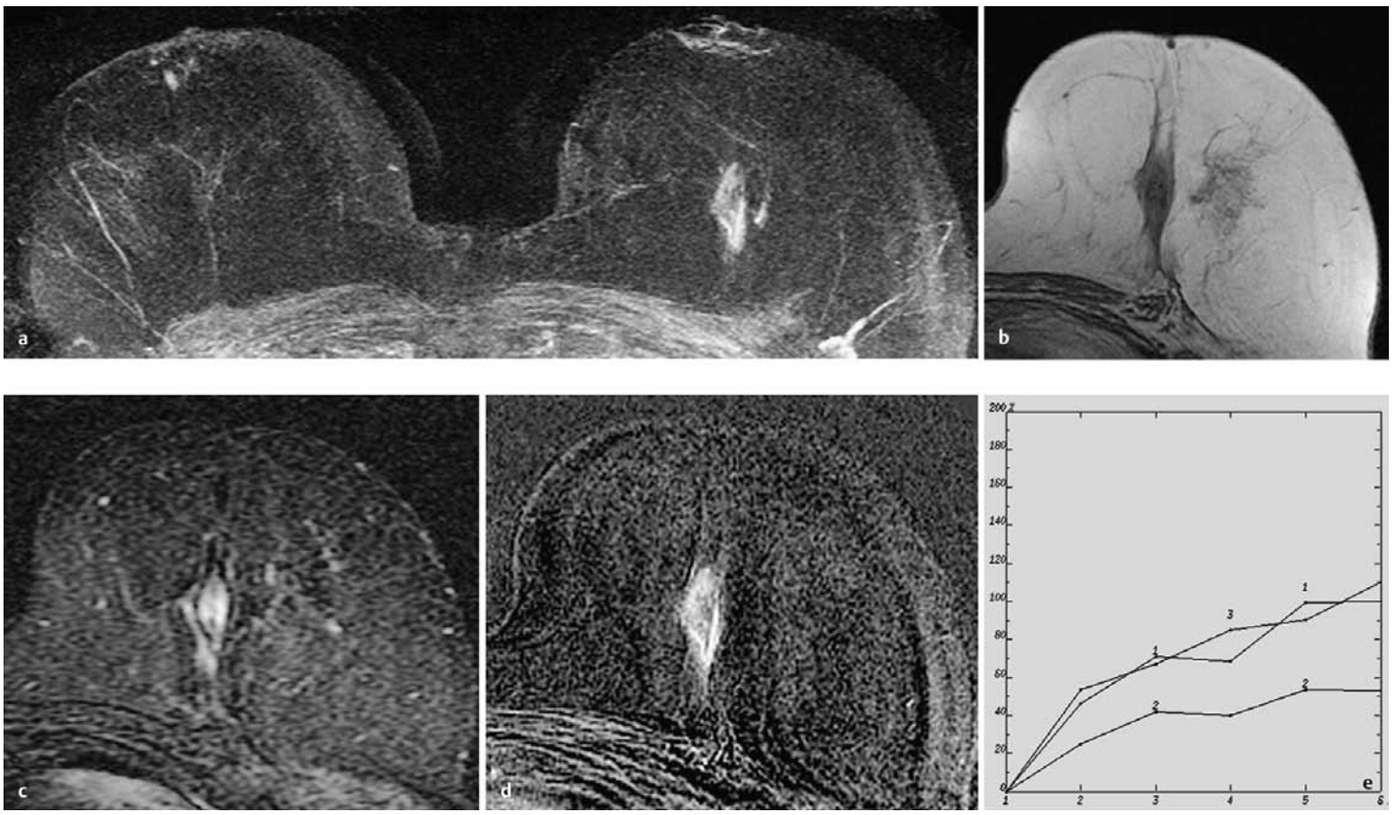


Fig. 9.15a–e Postoperative scar with significant inflammatory component. Breast-conserving therapy of the left breast 3 years before examination.

a Subtraction MIP: oblong enhancement area in the scar area of the left breast.

b T1w precontrast slice image (left breast): oblong scar area.

c IR T2w slice image (left breast): increased water content in scar area.

d Early subtraction slice image (left breast): strong enhancement of the entire scar area.

e TIC: moderate initial enhancement and persistent postinitial enhancement.

Histology after vacuum-assisted biopsy: granulomatous inflammation within scar tissue.

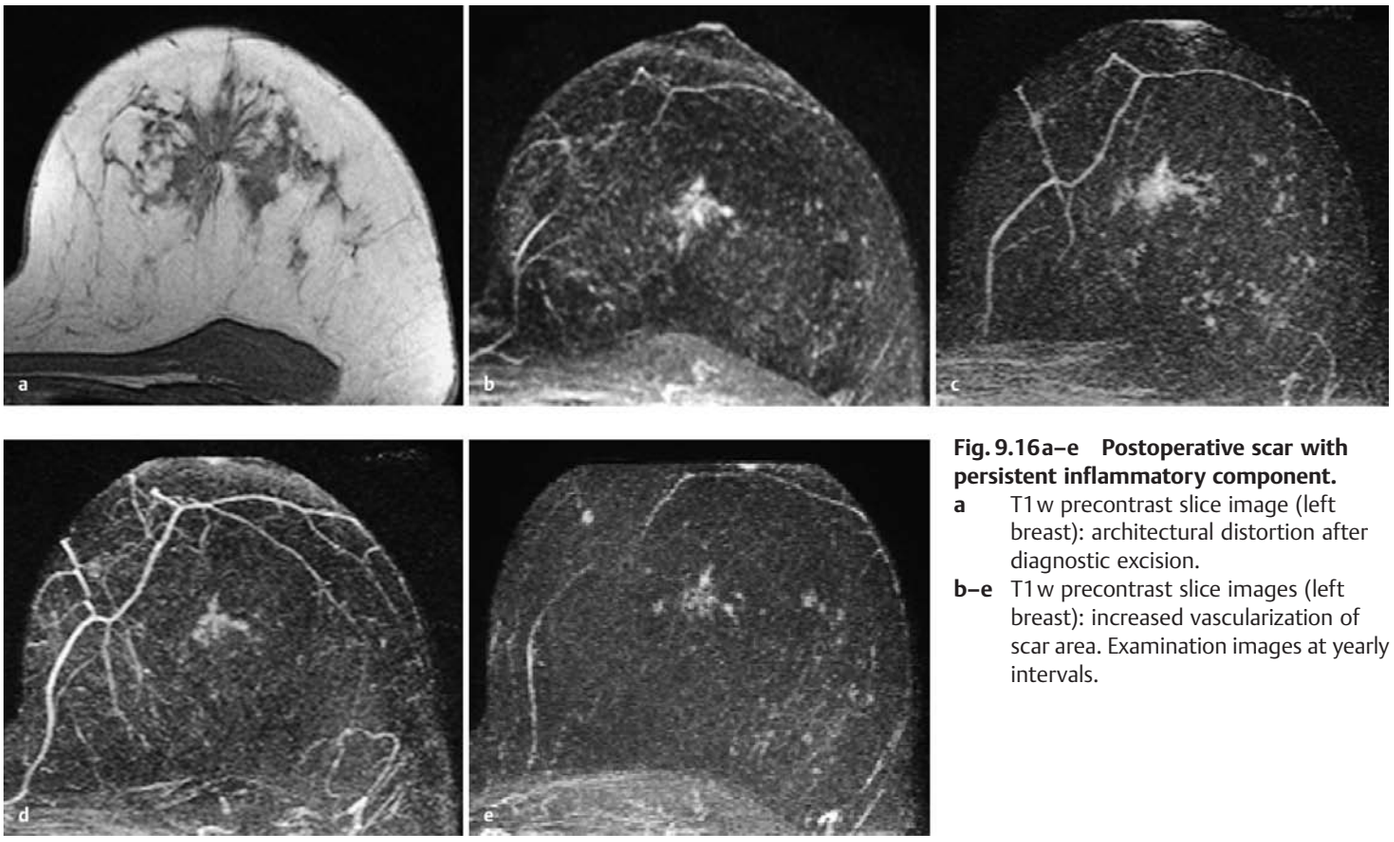


Fig. 9.16a–e Postoperative scar with persistent inflammatory component.

a T1w precontrast slice image (left breast): architectural distortion after diagnostic excision.

b–e T1w precontrast slice images (left breast): increased vascularization of scar area. Examination images at yearly intervals.

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