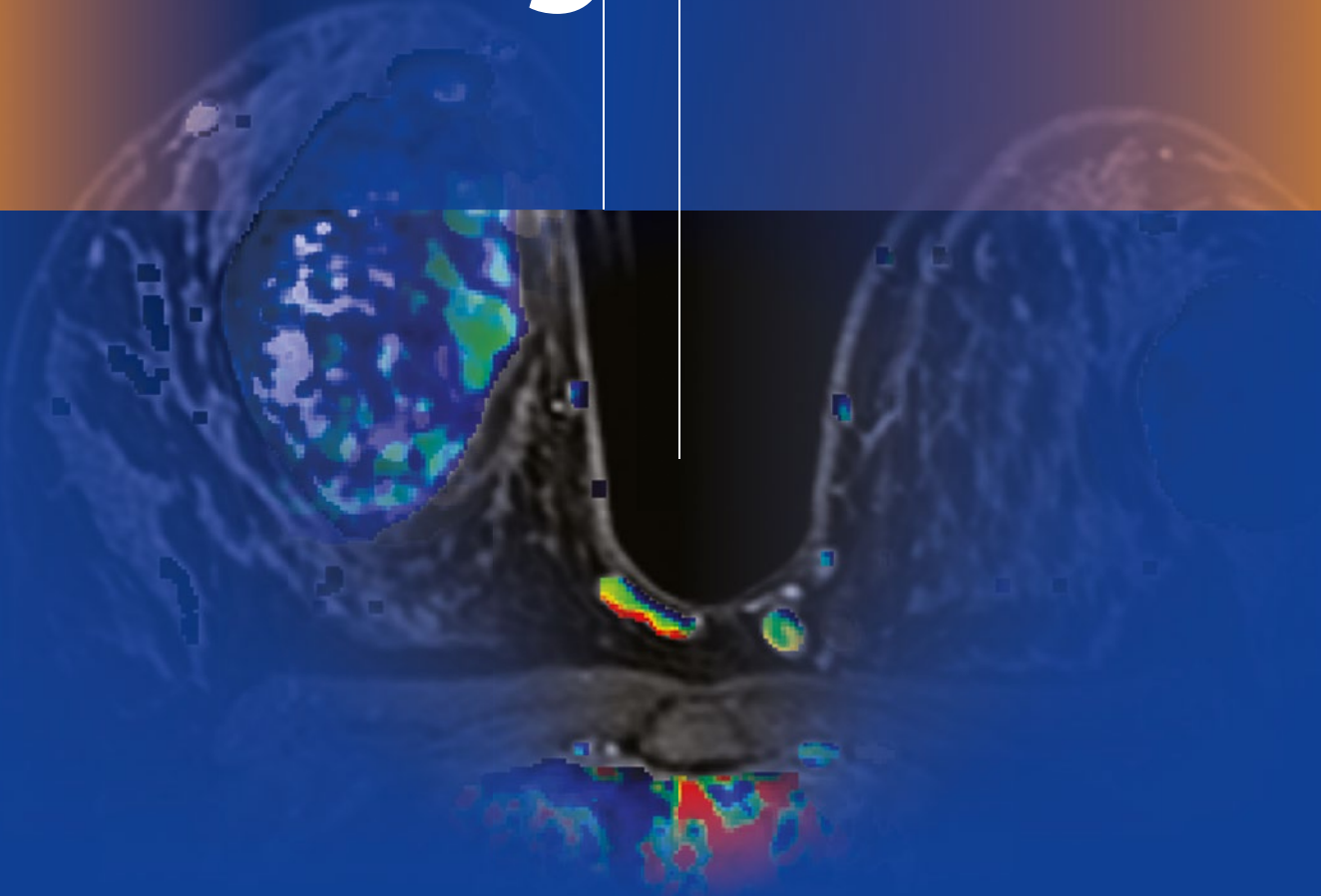


Richard Ha
Christopher E. Comstock
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Editors

Breast MRI Teaching Atlas



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 Springer

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To my loving parents (Kyungsub and Kehui Ha), my beautiful wife Karen, and my little princesses Madeleine and Esme, who have given my life joy and make me appreciate every day.

Richard Ha, MD

To my daughters Abby and Bronwyn.

Elizabeth A. Morris, MD

Preface

The purpose of the *Breast MRI Teaching Atlas* is to serve as a basic introduction to breast MRI. This book is case based, emphasizing pertinent breast MRI findings and common indications for breast MRI. The chapters are broadly separated based on benign and malignant breast pathology as well as commonly encountered breast MRI findings. Brief teaching points accompany each case, highlighting the importance of the findings rather than long and exhaustive discussion. The target audience for this book is medical students, residents, and breast imaging fellows, with the intention of being readable over a short period of time to provide an introduction to breast MRI. This book may also serve as a review for practicing general radiologists and clinicians involved in the care of breast cancer patients including surgeons, oncologists, and obstetricians/gynecologists.

New York, NY, USA
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Christopher E. Comstock, MD
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1.1 History

Four patients with T1-weighted sequence findings (Figs. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, and 1.8).

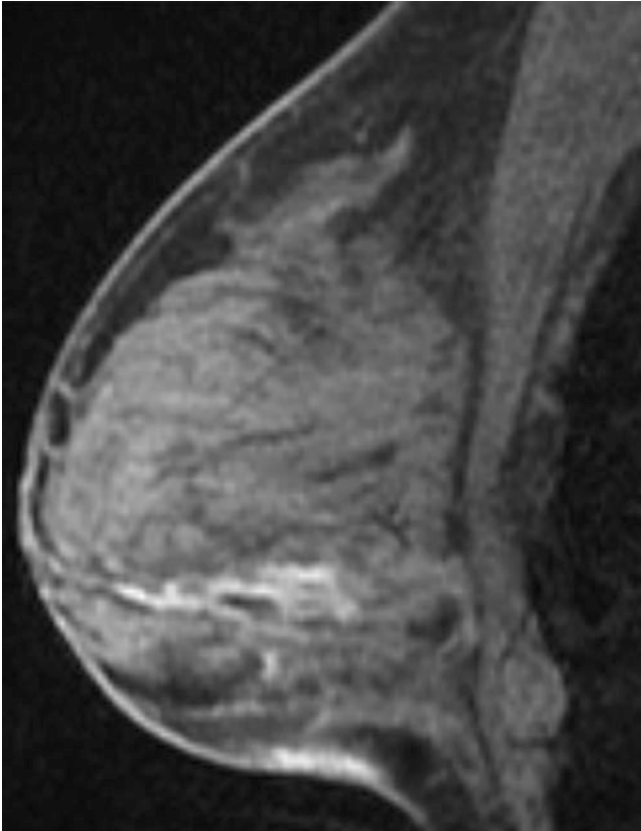


Fig. 1.1 Sagittal T1 fat-saturated pre-contrast image of the right breast

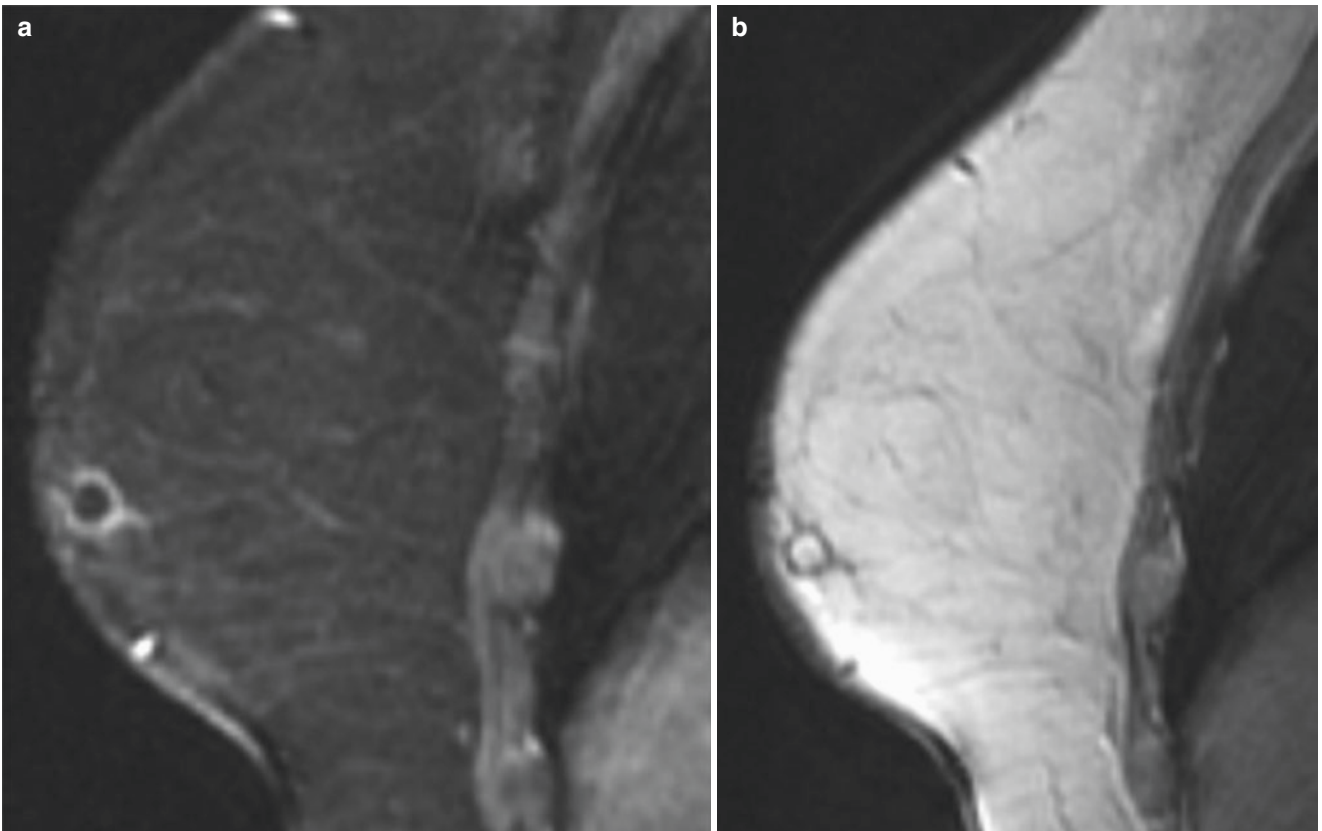


Fig. 1.2 Sagittal T1 fat-saturated post-contrast image of the right breast (a) and corresponding T1 non-fat-saturated image (b)

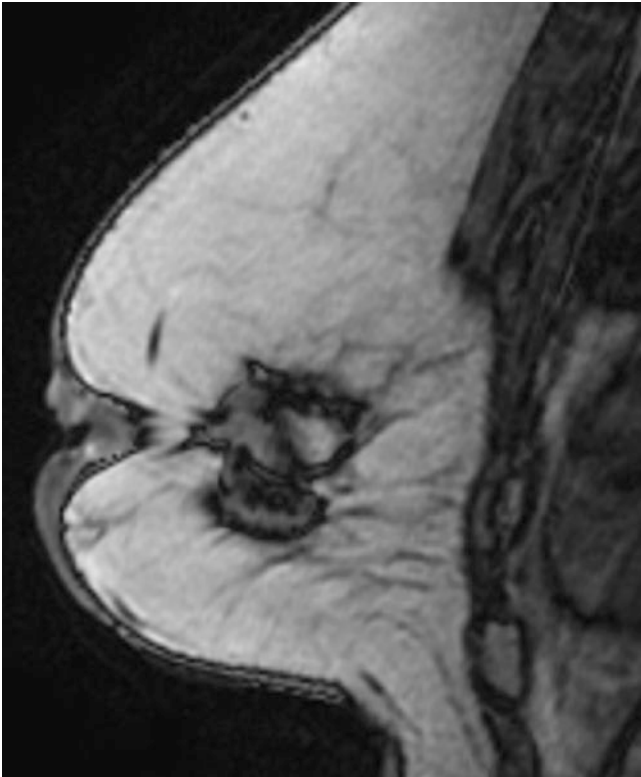


Fig. 1.3 Sagittal T1 non-fat-saturated image of the left breast

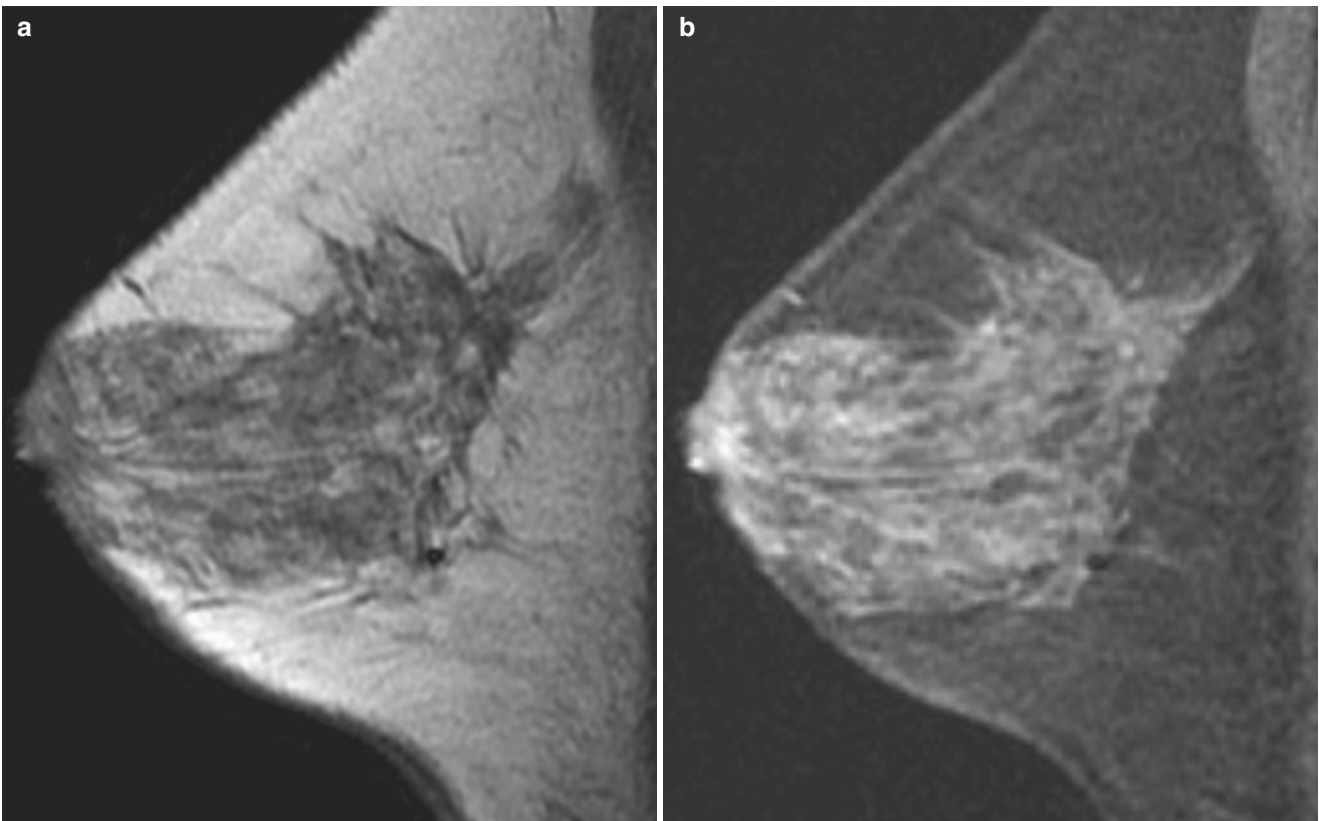


Fig. 1.4 Sagittal T1 non-fat-saturated image of the right breast (a) and corresponding T1 fat-saturated sequences (b)

1.1 T1-Weighted Sequence

Teaching Points Breast MRI should be performed on systems with at least 1.5 Tesla magnet strength with a dedicated breast coil. Usually, a pre-contrast T1-weighted gradient-echo sequence without fat saturation is the first sequence performed after the scout images. A T1-weighted non-fat-saturated sequence is obtained bilaterally, including axillae and chest wall, to distinguish fat from water-based tissues. The pre-contrast T1-weighted sequence is typically used to assess the amount of fibroglandular tissue and can be particularly helpful

in documenting the presence of high-signal hemorrhagic or proteinaceous fluid-filled, dilated ducts (Fig. 1.1). Radiologists should be aware of these T1-hyperintense ducts, which can cause potential misregistration artifact related to patient motion, leading to an apparent suspicious linear nonmass enhancement on post-contrast subtracted images. It is important to assess the pre-contrast T1 sequence before evaluating the post-contrast images. T1 non-fat-saturated images can be helpful in evaluating for fat necrosis by identifying central fat (Fig. 1.2). Biopsy clip artifact and architectural distortion can be better seen on the non-fat-saturated T1 sequence (Figs. 1.3 and 1.4).

Image Findings

Fig. 1.5 Hemorrhagic or proteinaceous debris in ducts. Sagittal T1 fat-saturated pre-contrast image of the right breast demonstrates several linear hyperintensities (*arrows*) in a ductal distribution in the lower breast, compatible with hemorrhagic or proteinaceous debris

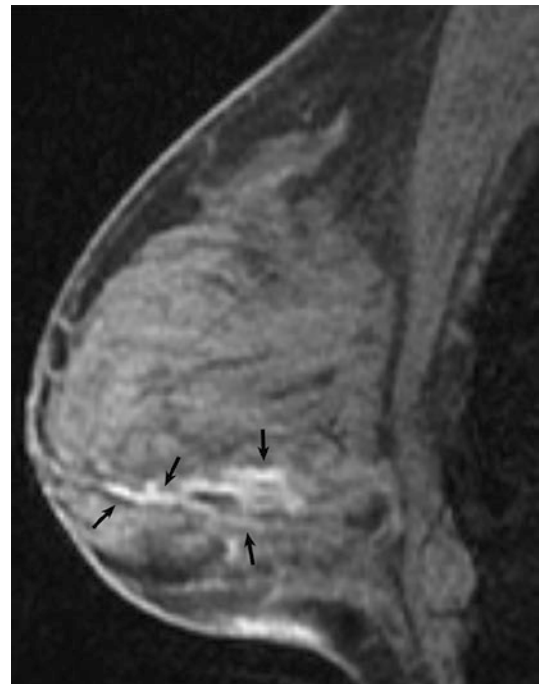
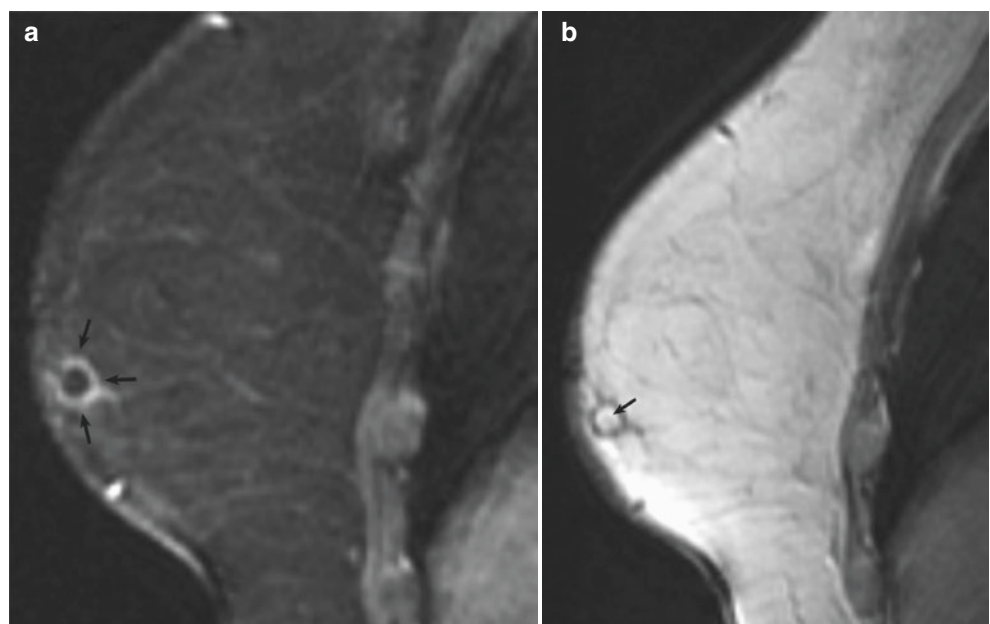


Fig. 1.6 Fat necrosis. (a) Sagittal T1 fat-saturated post-contrast image of the right breast demonstrates indeterminate rim enhancement (*arrows*). (b) The T1 non-fat-saturated image shows central fat (*arrow*), compatible with benign fat necrosis



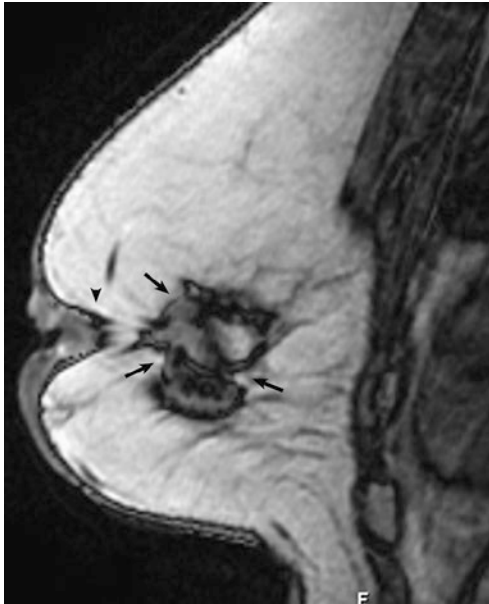


Fig. 1.7 Architectural distortion. In a patient with prior lumpectomy, the sagittal T1 non-fat-saturated image of the left breast illustrates architectural distortion in the central breast (*arrows*) and associated nipple retraction (*arrowhead*)

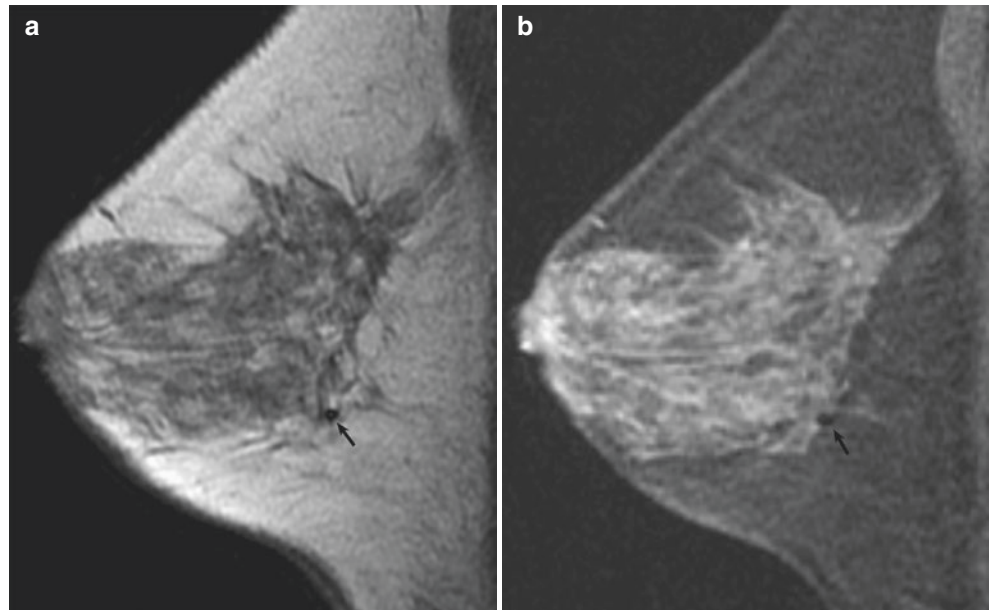


Fig. 1.8 Susceptibility artifact from biopsy clip. The susceptibility artifact from a biopsy clip (*arrow*) is more prominent on the T1 non-fat-saturated image of the right breast (**a**) than on the T1 fat-saturated sequences (**b**)

1.2 History

Four patients illustrating the range of the amount of fibroglandular tissue on breast MRI (Figs. 1.9, 1.10, 1.11, and 1.12).

1.2 Fibroglandular Tissue

Teaching Points At mammography, breast density is represented by the amount of fibroglandular tissue (FGT) in contrast to fat measured in two-dimensional views that may not reflect an accurate assessment. Breast MRI provides strong soft-tissue contrast between FGT and fat, and a more accurate three-dimen-

sional coverage of the entire breast. Evaluation of the amount of FGT is usually done on the T1-weighted sequences with and without fat suppression. According to the American College of Radiology (ACR) guidelines, the amount of FGT should be described in the Breast MRI report using the BI-RADS® four assessment categories of breast composition, which are defined by the visually estimated content of FGT within the breasts.

The amount of fibroglandular tissue (breast density) has been established as an independent risk factor associated with the development of breast cancer, which is three to five times higher in women with mammographically dense breasts than in women with predominantly fatty breasts.

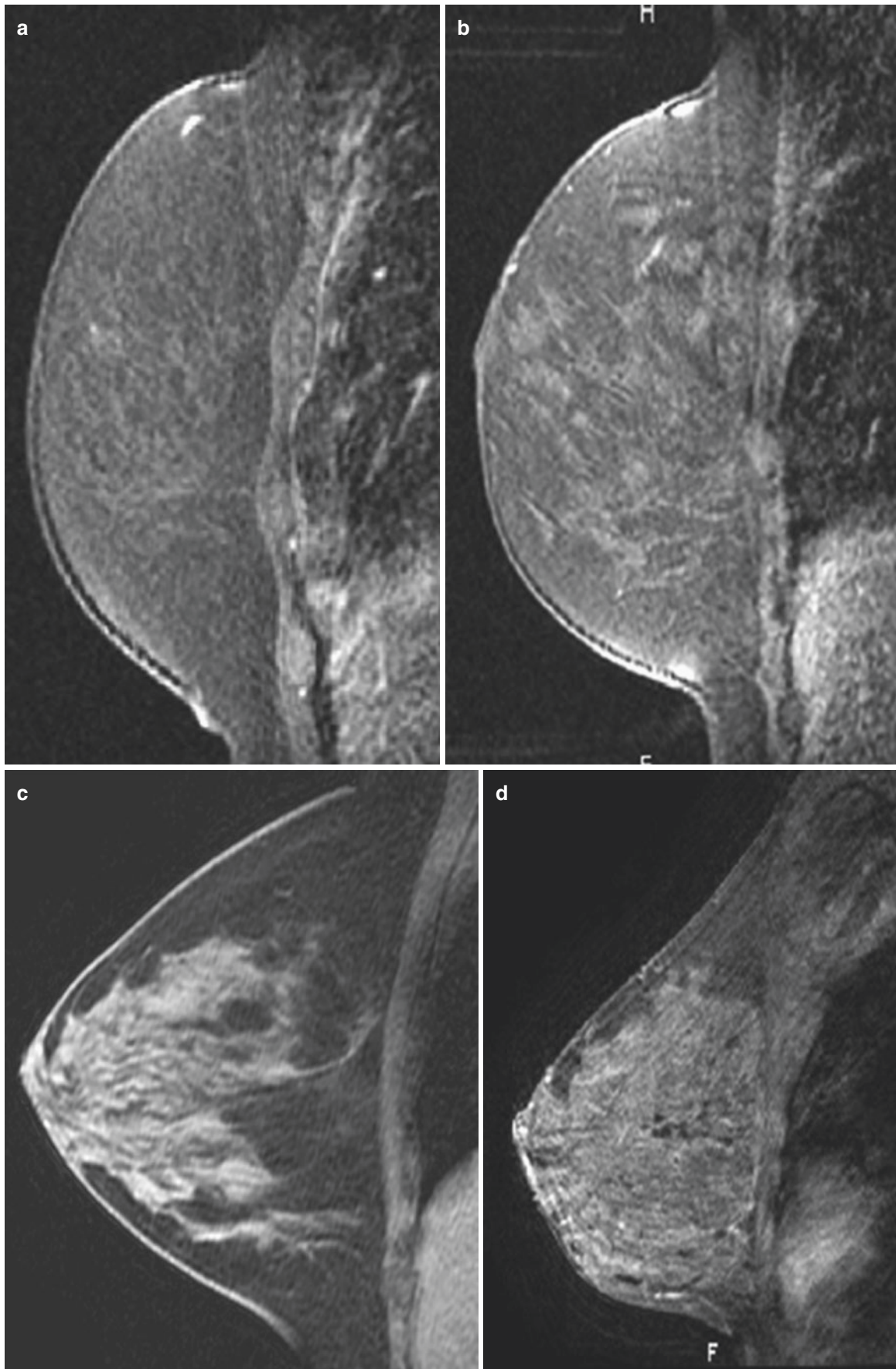


Fig. 1.9, 1.10, 1.11, and 1.12 Selected sagittal T1 post-contrast image (a) right breast demonstrates an almost entirely fatty breast (b) right breast shows scattered fibroglandular tissue. Selected sagittal

T1 pre-contrast image (c) right breast demonstrates heterogeneous fibroglandular tissue. Selected sagittal T1 post-contrast image (d) left breast demonstrates extreme fibroglandular tissue