
The Nipple-Areolar Complex: A Pictorial Review of Common and Uncommon Conditions

8

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8.1 Introduction

The nipple-areolar complex is a specialized region of the mammary gland. It is a major anatomic landmark of the breast, serves to drain and express breast milk during lactation, and contains specialized cells for the function [1, 2]. The nipple contains many sensory nerve ending and smooth muscle bundles. The latter perform an erectile function to facilitate nursing. The pigmented tissues of the areola contain numerous apocrine sweat glands and sebaceous glands, as well as hair follicles. The skin of the areola is thicker than the rest of the skin of the breast, tapering down toward the limbus of the areola. The surface of the nipple itself is irregular and contains numerous crevices. The mammary duct orifices are at the bottom of these crevices [1]. The nipple-areolar complex may be affected by a broad spectrum of disease [2-4].

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8.2 Normal Appearance and Normal Variants

8.2.1 Montgomery Tubercles

The pigmented tissues of the areola include numerous apocrine sweat glands and sebaceous glands, as well as hair follicles. The glands help lubricate the nipple-areolar surface. The nipple-areolar complex contains raised structures on the surface of the areola known as Montgomery tubercles (Fig. 8.1) [2-4].

8.2.2 Nipple Retraction or Inversion

The terms retraction and inversion are used interchangeably, but that is incorrect usage. Nipple inversion should only be used when the entire nipple is pulled inward, whereas retraction should be used when the nipple only has an inward slit-like area [2].

Nipple retraction and inversion are either congenital or acquired and either unilateral or bilateral [2, 3]. Nipple inversions typically occur during puberty. Nipple inversions are normal variants of the nipple position or result from the development of fibrous tissue between the nipple and the subareolar parenchyma. This

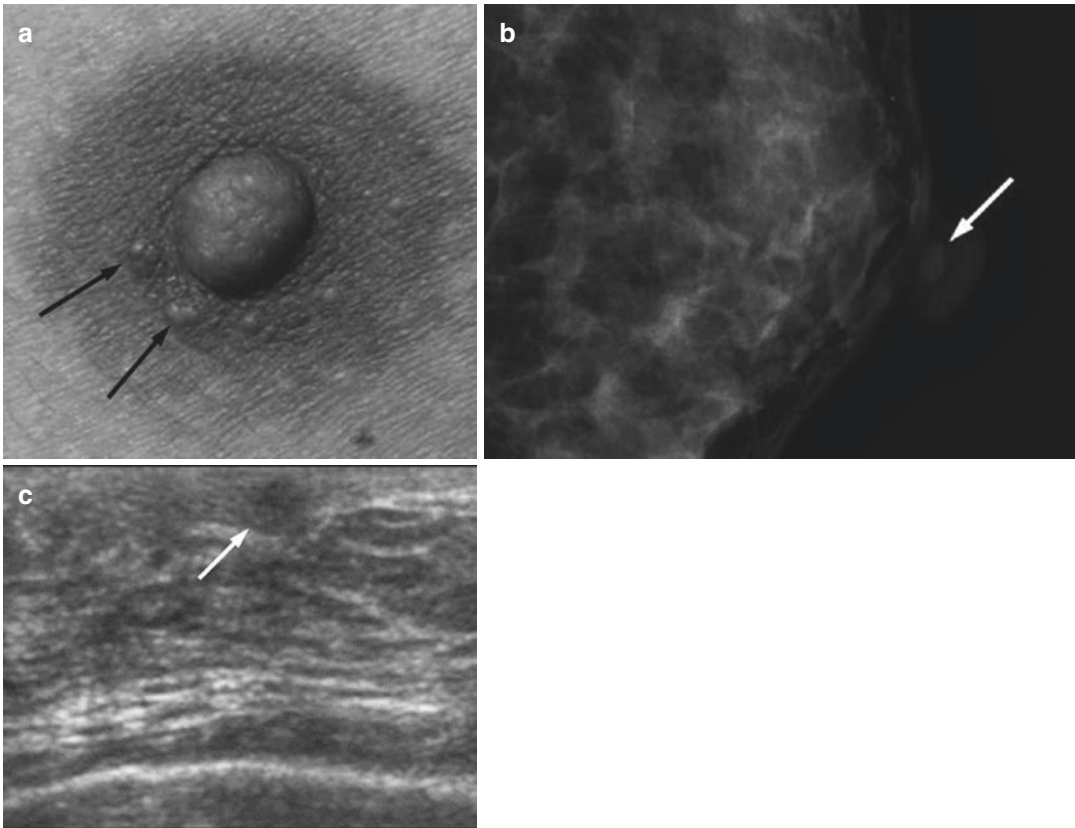


Fig. 8.1 Montgomery tubercle in a 54-year-old woman. (a) Small round elevations on the surface of the areola. (b) Left mediolateral oblique mammogram showing well-

defined small round areolar nodule (*arrow*). (c) Sonogram showing prominent isoechoic areolar nodule (*arrow*)

condition hinders breast-feeding and predisposes to mastitis and abscess formation (Fig. 8.2) [5].

8.2.3 Accessory Nipples

Accessory nipples most commonly occur in the anterosuperior abdominal wall below the breast, but they may develop anywhere along the course of the embryologic mammary ridge, the so-called milk line, which extends bilaterally from the axilla to the inguinal area. The most inferior location of the accessory nipples has been in the proximal thigh. Accessory nipples may be confused with moles because they are pigmented [2–4].

8.3 Benign Processes

Benign lesions that affect the nipple-areolar complex are varied. These lesions include benign calcifications, inflammation, duct dilations, intraductal papillomas (IDPs), fibroadenomas, neurofibromatosis, and dermatosis of the nipple.

8.3.1 Benign Calcifications

Nipple calcifications are rare [3, 6]; however, the glands and hair follicles of the nipple-areolar complex contain calcifications [3, 4]. Lucent-centered, spherical, or polygonal calcifications are generally benign calcifications, including the

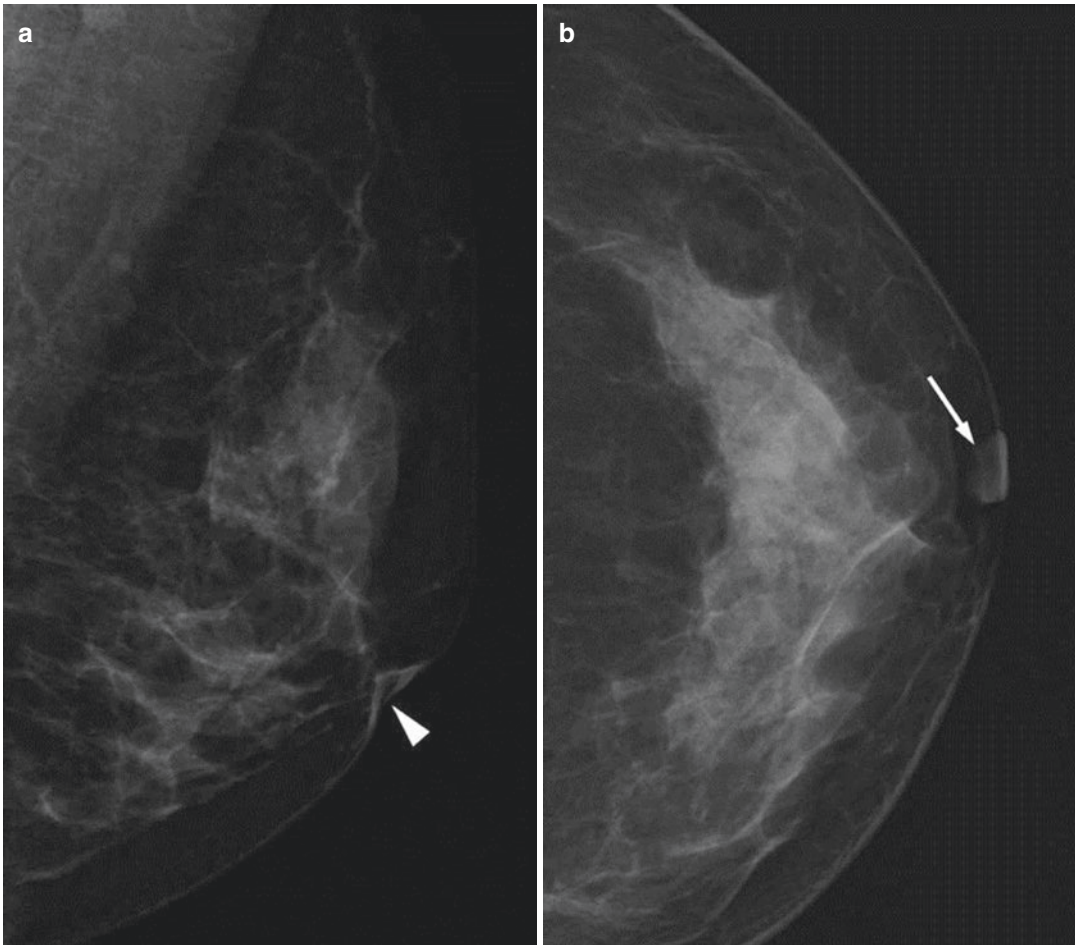


Fig. 8.2 Nipple inversion in a 49-year-old woman. (a) Right craniocaudal mammogram showing subareolar pseudo-mass (*arrow*) representing mammographically

inverted nipple. (b) Right mediolateral oblique mammogram showing gross inversion

calcified debris in ducts, fat necrosis, and skin calcifications. Skin calcifications are usually scattered widely over the breast (Fig. 8.3). Multiple benign dermal calcifications often develop in a classic pattern within the periareolar surgical scars after breast reduction. Occasionally, they can project as intramammary deposits, but this problem can be solved by using tangential views [6].

8.3.2 Inflammation

Periductal mastitis is a suppurative inflammatory disease of the mammary gland and results from

the obstruction of a small duct beneath the areola. Occasionally, an abscess (a collection of pus) may develop. A subareolar abscess is unusual. Most cases of mastitis and breast abscesses occur during lactation, whereas subareolar abscesses mostly occur in non-lactating young and middle-aged women [3, 7].

Abscesses appear as irregular, poorly defined, or spiculated hyperdense masses caused by edema and inflammation on a mammography and cystic masses with low-level internal echoes, which are difficult to differentiate from intracystic neoplasm, on sonography (Fig. 8.4). When an abscess is suspected and associated with a mammographically suspicious finding, follow-up imaging in

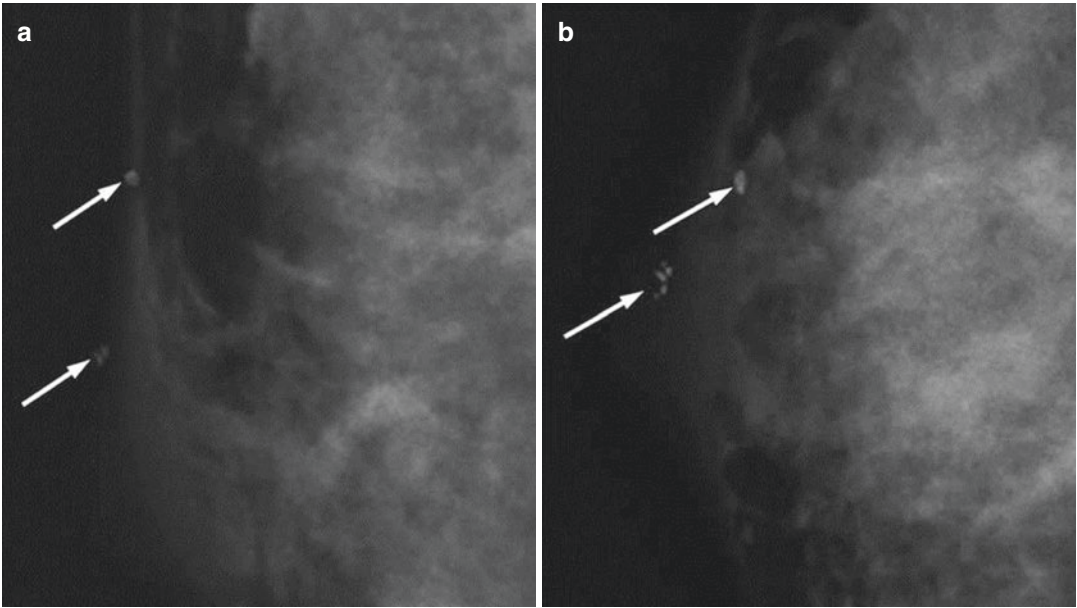


Fig. 8.3 Benign skin calcifications in a 36-year-old woman. (a) Right mediolateral oblique and (b) right craniocaudal digital mammograms showing multiple calcifi-

cations with central lucency diagnostic of benign skin calcifications (*arrow*) in the right nipple and subareolar region

4–6 weeks is recommended to ensure resolution of the suspicious mammographic findings.

A history of fever, breast pain and response to antibiotics help differentiate an abscess from a neoplasm. Because of the presence of breast pain and tenderness, clinical and mammographic examinations are often inadequate. Therefore, sonography is optimal imaging modality for assessment of mastitis or abscess of the breast [2, 3, 7, 8].

8.3.3 Mammary Duct Ectasia

Duct ectasia presents with a nipple discharge, nipple retraction, pain, or tenderness [3, 8]. Tubular or branching structures that converge toward the nipple are characteristic mammographic features of duct ectasia. Tubular or branching structures are most commonly seen in the subareolar area. Bilateral symmetric subareolar ductal dilatation is common in postmenopausal women but has no clinical importance [9].

However, if asymmetric subareolar duct dilatation is detected on mammograms, spot magnification views plus sonography may prove helpful in evaluating for an underlying mass, such as IDP or carcinoma [3, 9].

On sonography, dilated ducts are filled with fluid, and concentrated secretions and debris are visible as intraductal echoes, which are difficult to differentiate from intraductal tumors (Fig. 8.5) [3, 8, 9]. Movement of echogenic materials on real-time sonography may be a diagnostic feature of ductal ectasia [3].

8.3.4 Intraductal Papilloma (IDP)

Intraductal papillomas are relatively common benign neoplasm originating from proximal ducts or retroareolar mammary ducts [10]. Papillomas are known to occur anywhere within the ductal system and are classified into central and peripheral types. Central types tend to be single and located in the subareolar region within

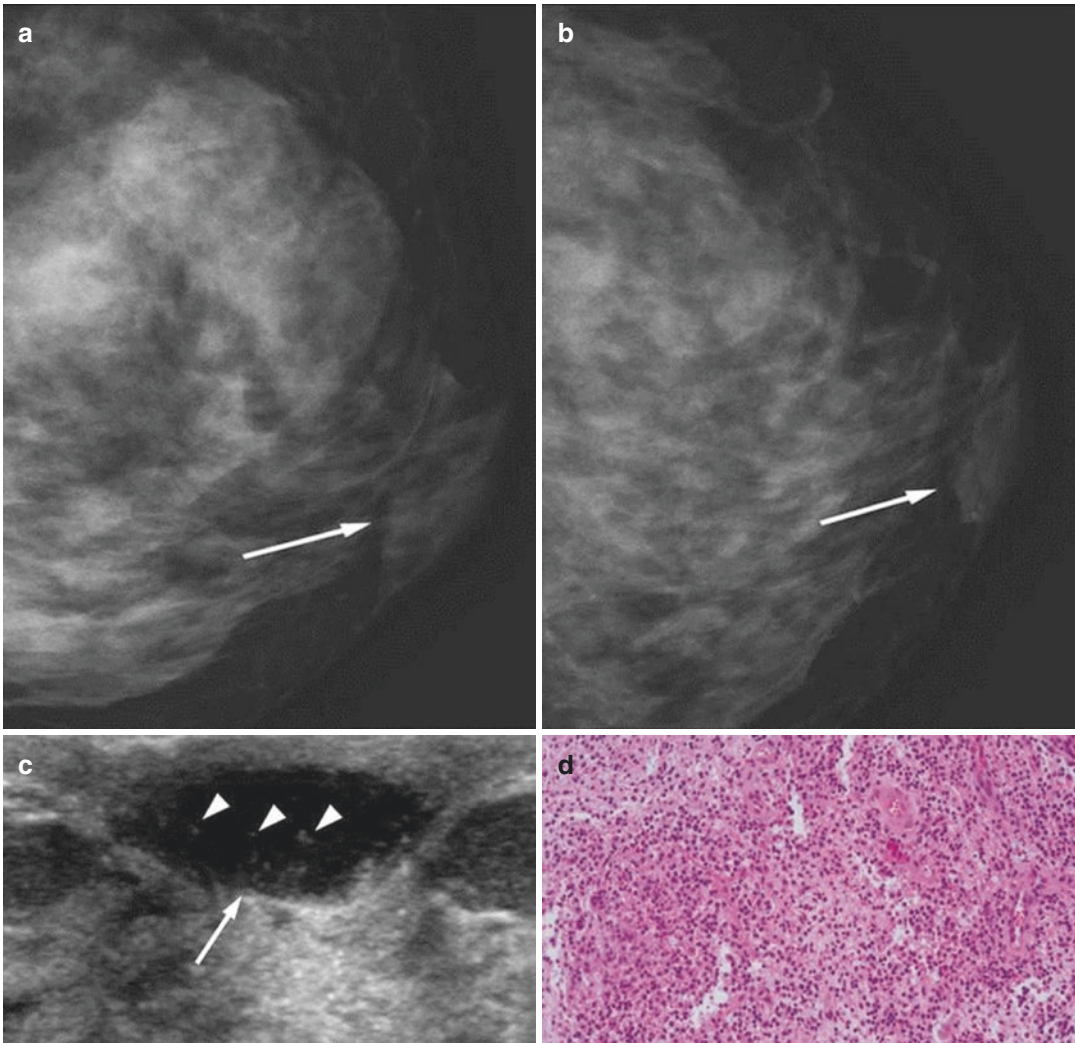


Fig. 8.4 Subareolar abscess in a 43-year-old woman. (a) Left mediolateral oblique and (b) left craniocaudal mammograms showing isodense ovoid subareolar focal asymmetry (*arrow*). (c) Sonogram showing a hypoechoic mass (*arrow*) with focally thick irregular microcalcification walls and mobile internal echogenic debris (*arrowheads*).

(d) Excisional biopsy specimen showing congestion with a chronic inflammatory infiltrate consisting of lymphocytes, plasma cells, histiocytes, and Langhans type of giant cells (hematoxylin-eosin, original magnification $\times 200$)

major ducts, whereas peripheral types are commonly multiple within the terminal ductal-lobular unit. Peripheral duct types have an increased risk of carcinoma, which is directly related to the degree of cellular atypia. Histologically, papillomas reveal hyperplastic proliferation of the ductal epithelium, having a frond-like growth pattern with a branching fibromuscular core of myoepithelial and epithelial cells [11].

The sonographic features of IDP have three basic patterns: (1) an intraductal mass with or without duct dilatation, (2) an intracystic mass, and (3) a predominantly solid pattern with an intraductal mass totally filling the duct (Fig. 8.6). Dilated ducts or cysts with an intraductal or intracystic solid mass are the hallmark of IDP [11].

Small IDPs are often mammographically occult. A moderately dilated duct may be observed as pro-

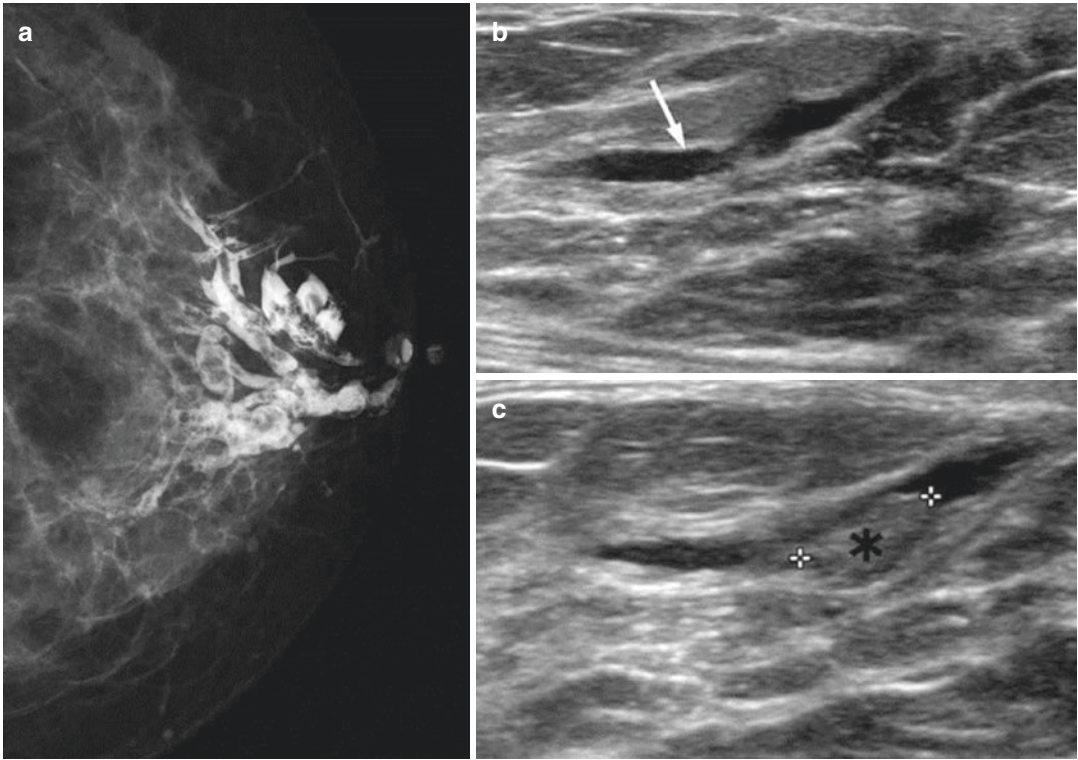


Fig. 8.5 Mammary duct dilatation in a 49-year-old woman. (a) Left craniocaudal galactogram showing multifocal filling defects in the dilated ducts. (b, c) Sonograms

showing fluid-filled structures (b, arrow) behind the nipple with echogenic sludge (c, asterisk)

gressively tapering band-like density that converges toward the nipple. Large IDPs may show a focal, well-circumscribed hyperdense mass [12].

8.3.5 Fibroadenomas

Fibroadenomas are the most common benign tumor of the breast. They are composed of epithelium and stroma of the terminal ductal-lobular units. Gross pathologic specimens of fibroadenomas usually show round, oval, or lobulated shapes, which are sharply defined by a pseudocapsule of compressed parenchyma. Therefore, fibroadenomas are typically well-circumscribed, round, or oval solid masses associated with smooth contours and homogeneous internal echoes on sonography [13, 14]. However, some fibroadenomas have atypical sonographic findings, such as poorly defined margin or irregular

shape with heterogeneous internal echoes or posterior shadowing (Fig. 8.7) [15]. A poorly defined margin or an irregular shape is associated with interdigitation of the surrounding parenchyma with a mass [15, 16]. Other atypical sonographic findings, such as a heterogeneous internal echo texture and posterior shadowing, are related to dilated ducts, phyllodes, collagen bundles, adenosis, and microcalcifications [15–19].

8.3.6 Neurofibromas

Neurofibromas are common benign tumors that arise from the peripheral nervous system. Most neurofibromas occur in the skin of the trunk. However, breast involvement is very rare. However, these lesions are frequently seen in patients with neurofibromatosis and are most common in the areolar area [7, 20, 21].

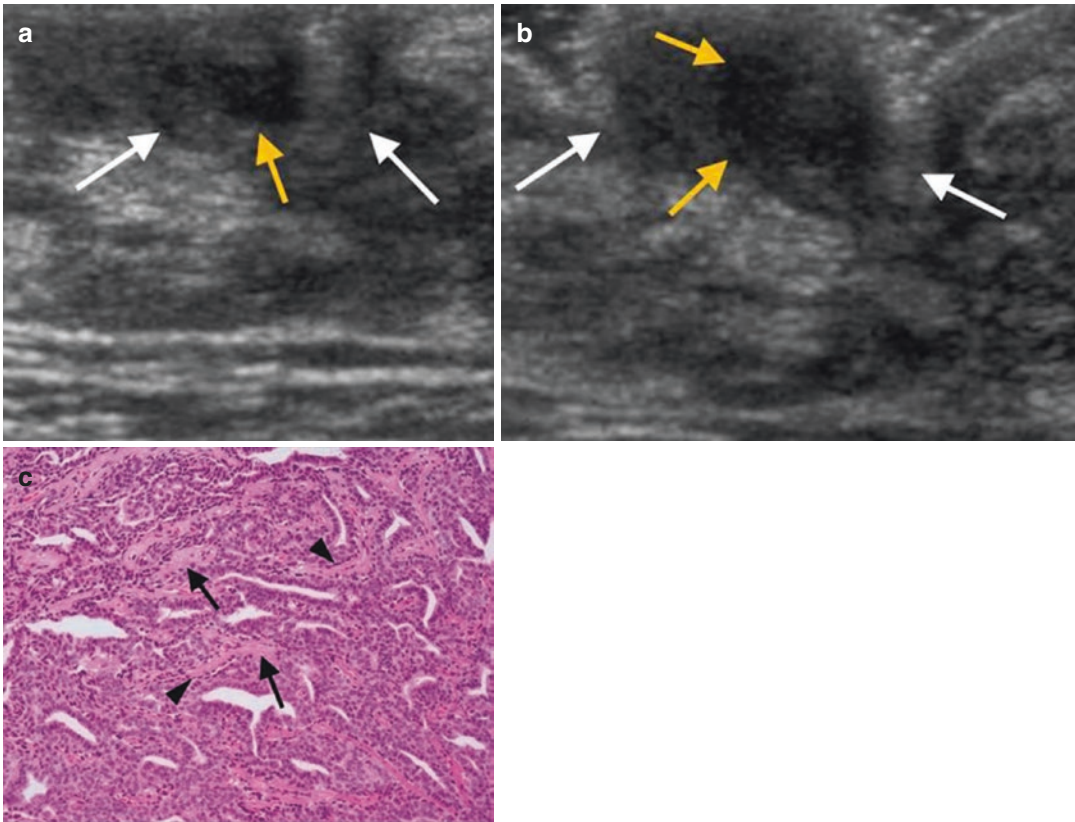


Fig. 8.6 Intraductal papilloma (IDP) in a 39-year-old woman. (a, b) Sonograms showing well-defined hypoechoic nodule (yellow arrows) in the left nipple (white arrows). (c) Microductectomy specimen showing

prominent fibrovascular cores (arrows), lined by a benign myoepithelial cell layer (hematoxylin-eosin, original magnification $\times 200$)

Neurofibromas are oval or round with a well-circumscribed margin on mammography and sonography (Fig. 8.8). On sonography, they have hypoechoic nodules with a posterior acoustic enhancement, resembling cysts. This effect has been described with other solid tumors of uniform cellularity, such as a lymphoma [21–23].

8.3.7 Dermatoses of the Nipple and Areola

Dermatosis of the nipple and areola is rare. Neoplastic dermatoses can be underestimated

because early dermatoses are scaly and erythematous and can be misdiagnosed as eczema or an inflammatory skin disorder. The most common neoplastic dermatosis is Paget's disease, which presents as a well-demarcated erythematous area, sometimes erosive, oozing, or hyperkeratotic. In 98.5–100% of cases, Paget's disease is associated with underlying breast carcinoma. Other neoplastic dermatoses of the nipple include nipple adenomas, soft fibroma (Fig. 8.9), epidermal cyst, and cellular blue nevi. Infectious dermatoses (viral warts (Fig. 8.10), molluscum contagiosum, and scabies) are accompanied by lesions in other sites [24–26].

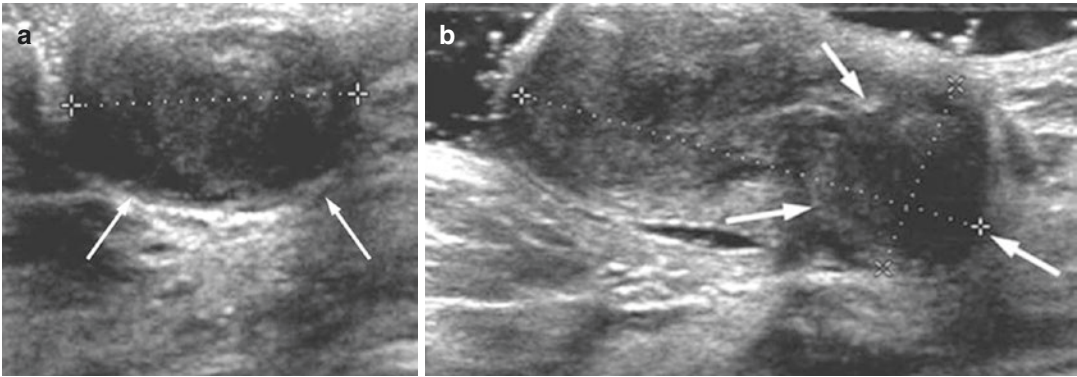


Fig. 8.7 Fibroadenoma in a 33-year-old woman. (a, b) Sonograms showing a relatively poorly marginated round mass (arrows) with a heterogeneous internal echo and posterior enhancement beneath the nipple. The long set of calipers in B measures the nipple and mass together

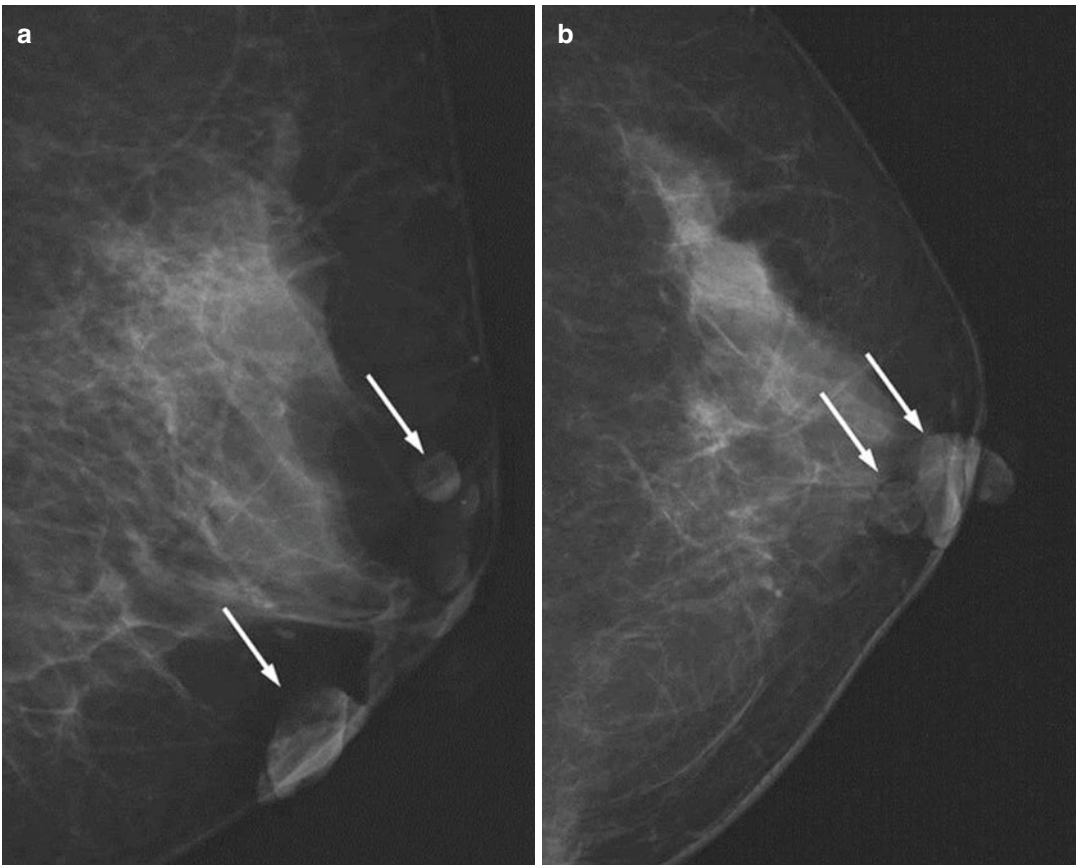


Fig. 8.8 Neurofibromas in a 33-year-old woman. (a) Left mediolateral and (b) left craniocaudal mammograms showing several round and oval well-circumscribed isodense skin nodules (arrows) in the periareolar region. (c, d) Sonograms showing well-circumscribed, smooth-
marginated, hypoechoic masses (arrows) located intracutaneously. NI indicates nipple. (e) Excisional biopsy specimen showing spindle cells with fibrillar cytoplasm and elongated nuclei (hematoxylin-eosin, original magnification $\times 200$)

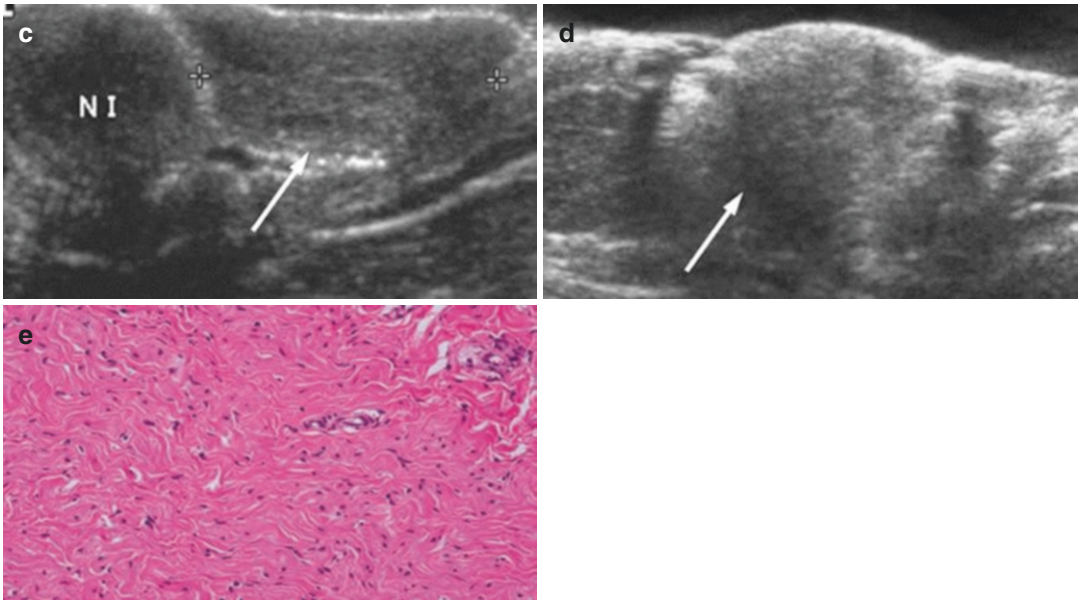


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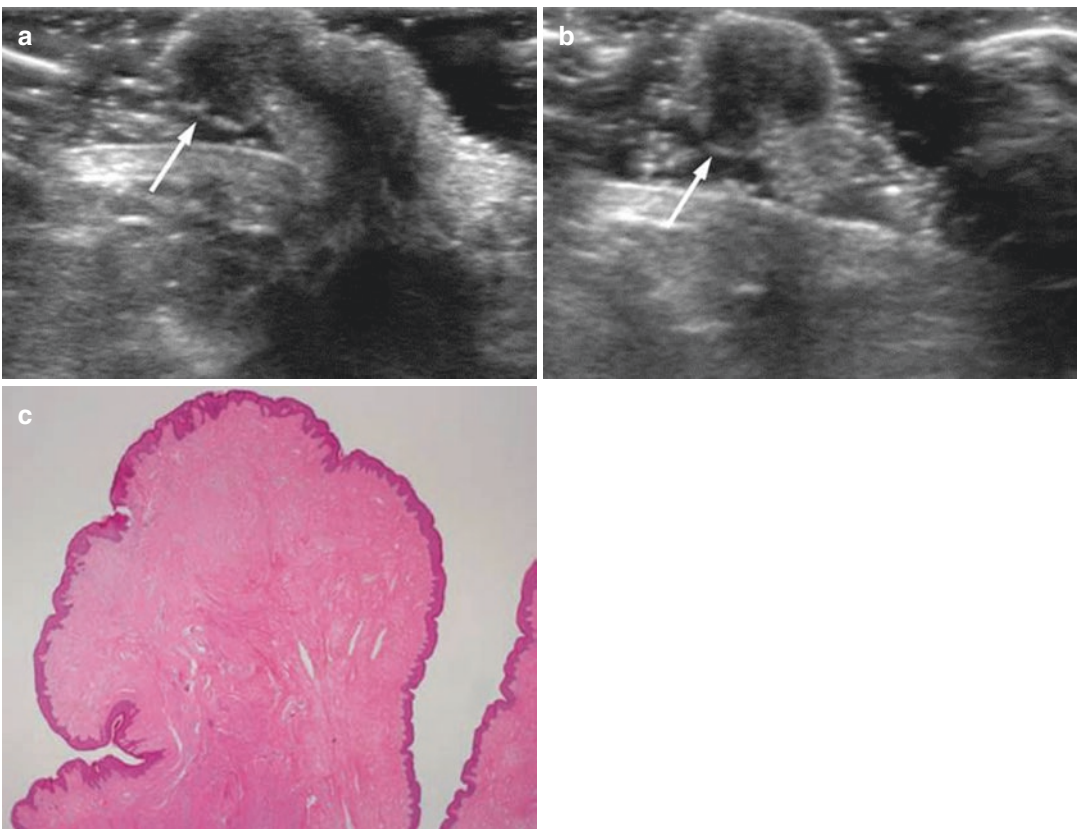


Fig. 8.9 Soft fibroma in a 23-year-old woman. (a, b) Sonograms showing a hypoechoic mass (*arrows*) arising from the tip of the left nipple. (c) Excisional biopsy specimen showing the epidermis raised in a papilliform shape

and underlying loose collagenous stroma with scattered spindle cells and dilated capillaries (hematoxylin-eosin, original magnification $\times 200$)

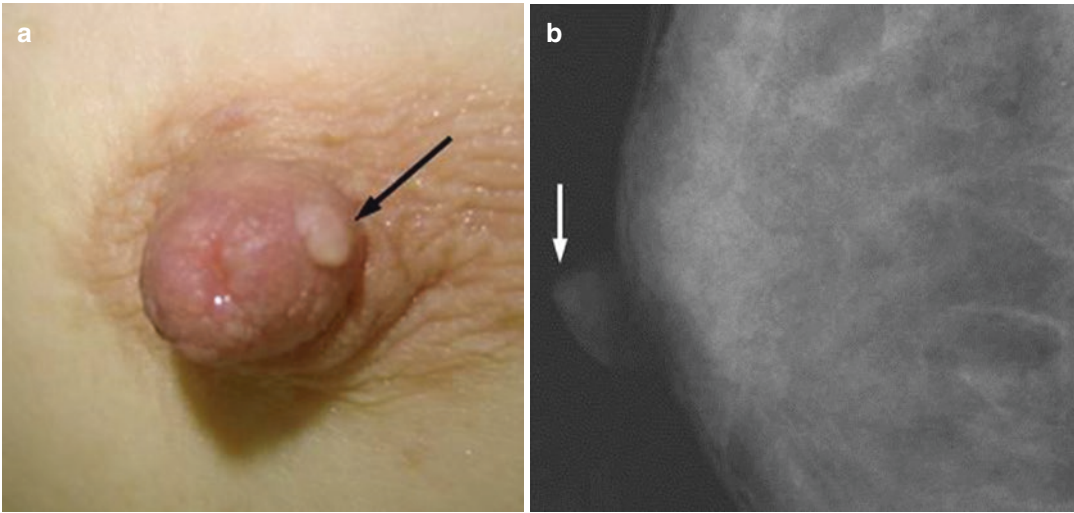


Fig. 8.10 Nipple wart in a 34-year-old woman. (a) Exophytic cutaneous nodular lesion (*arrow*). (b) Right mediolateral oblique mammogram showing a benign-looking nodule in superior portion of the nipple (*arrow*)

8.4 Malignant Processes

8.4.1 Paget's Disease

Paget's disease of the breast is a rare disorder of the nipple-areolar complex, constituting 0.5–5% of all breast cancer, and is often associated with an underlying in situ or invasive carcinoma [27].

Eczematoid change and soreness, burning, and an itching sensation of the nipple-areolar complex are common and early symptoms. The later stages of Paget's disease of the breast are characterized by ulceration, crusting, and serous or bloody discharge [28].

Paget's disease of the breast shows malignant calcifications at the level of the nipple or elsewhere in the breast, skin thickening, nipple retraction, and a discrete mass or masses on mammography. However, mammographic findings are normal in half of patients with Paget's disease of the breast [3].

Magnetic resonance imaging (MRI) is useful to diagnose Paget's disease of the breast and plays an important role in the selection of patients with Paget's disease for breast-conserving surgery without clinical or mammographic evidence of breast carcinoma. Magnetic resonance images show abnormal nipple enhancement and linear

clumped enhancement indicative of ductal carcinoma in situ in association with Paget's disease (Fig. 8.11) [3, 27, 29].

8.4.2 Carcinoma

Malignant masses of the nipple-areolar complex may be more difficult to diagnose than cancers elsewhere in the breast, because subareolar masses can be easily confused with normal nipple structures on mammography. Therefore, additional diagnostic mammographic views (spot compression with or without magnification) may be used to improve the visibility of subareolar masses. On sonography, subareolar masses or intraductal lesions may be more easily identified than on mammography [1, 3]. Contrast-enhanced MR imaging is useful when mammographic and sonographic findings are inconclusive (Figs. 8.12 and 8.13) [3].

Underlying cancer may originate immediately deep to the nipple or extend from another location in the breast to the nipple-areolar complex [1–3]. Nipple retraction and ulceration are secondary signs of malignancy and may occur with the extension of advanced breast cancer to the skin surface [3, 4].

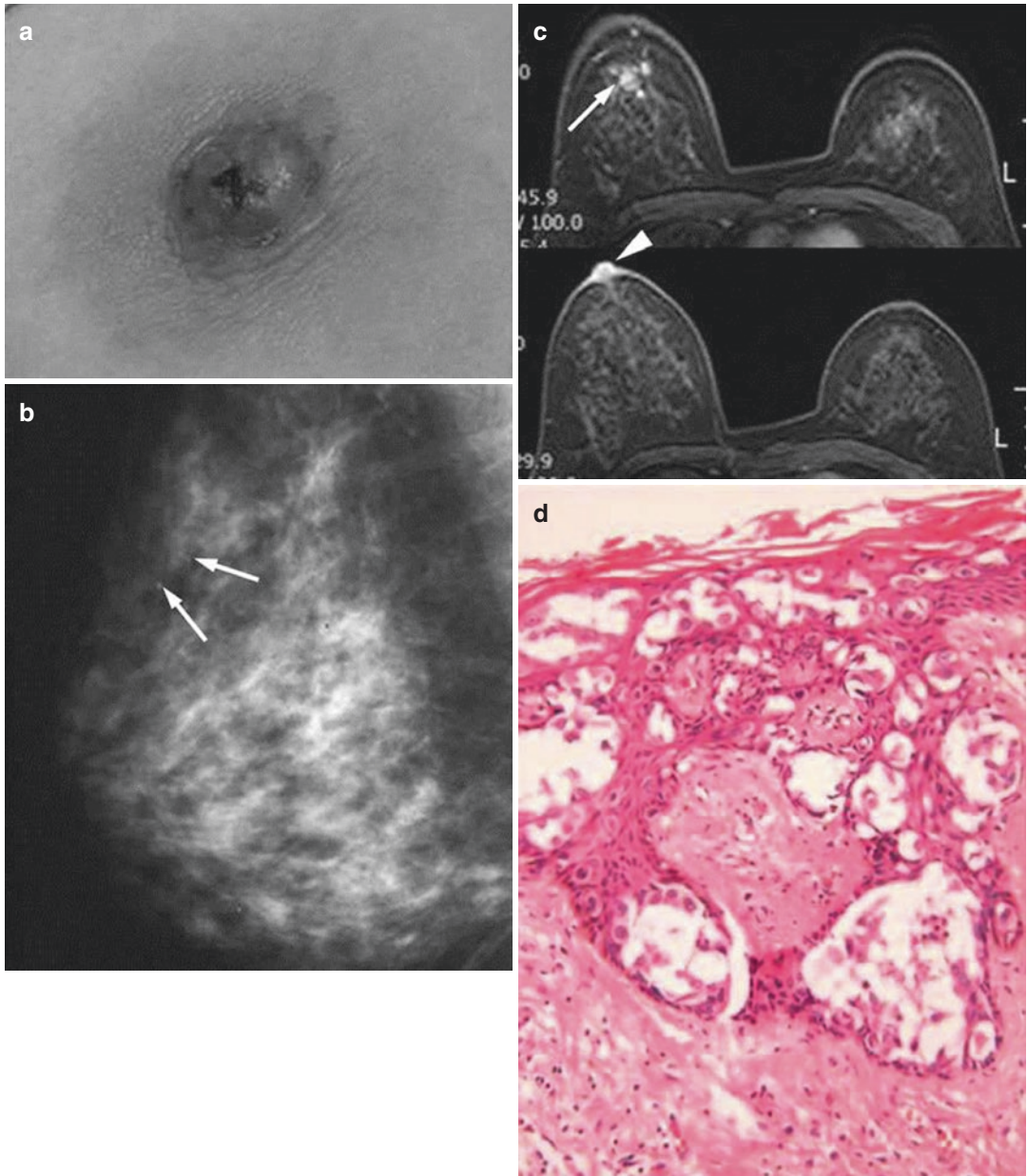


Fig. 8.11 Paget's disease in 46-year-old women. **(a)** Ulceration, crusting, and eczema at the nipple. **(b)** Right mediolateral oblique mammogram showing multiple microcalcifications in the upper portion (*arrows*). **(c)** Axial contrast-enhanced MRI showing multiple nodular enhancement in the upper portion of the right breast (*arrow*) and

enhancement of ipsilateral nipple-areolar complex (*arrowhead*). **(d)** Mastectomy specimen showing nests of malignant Paget cells predominantly involving the lower layers of the epidermis. The cytoplasm of the tumor cells contains abundant pale-staining granular mucinous material (hematoxylin-eosin, original magnification $\times 200$)

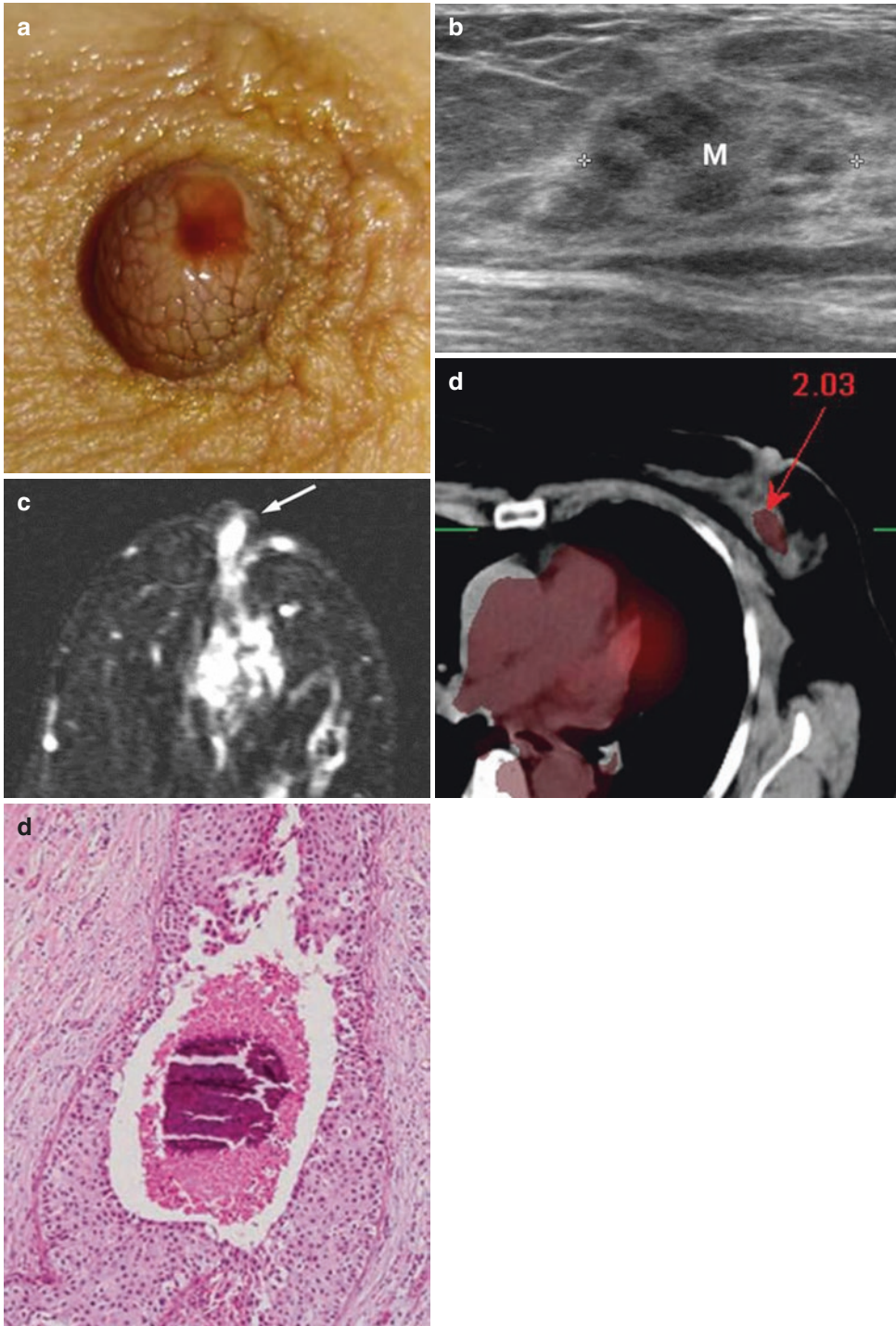


Fig. 8.12 Ductal carcinoma in situ in a 51-year-old woman. (a) Bloody nipple discharge. (b) Sonogram showing a lobulated hypoechoic lesion (*M*), a finding suggestive of malignancy. (c) Axial contrast-enhanced subtraction MRI showing a nodular clumped linearly enhanced lesion with direct invasion of the nipple (*arrow*). (d) Positron

emission tomogram showing a hypermetabolic subareolar lesion (*arrow*; maximum standardized uptake value, 2.03) in the left breast. (e) Mastectomy specimen showing central necrosis, calcification, and a high nuclear grade, findings suggestive of ductal carcinoma in situ (hematoxylin-eosin, original magnification $\times 200$)

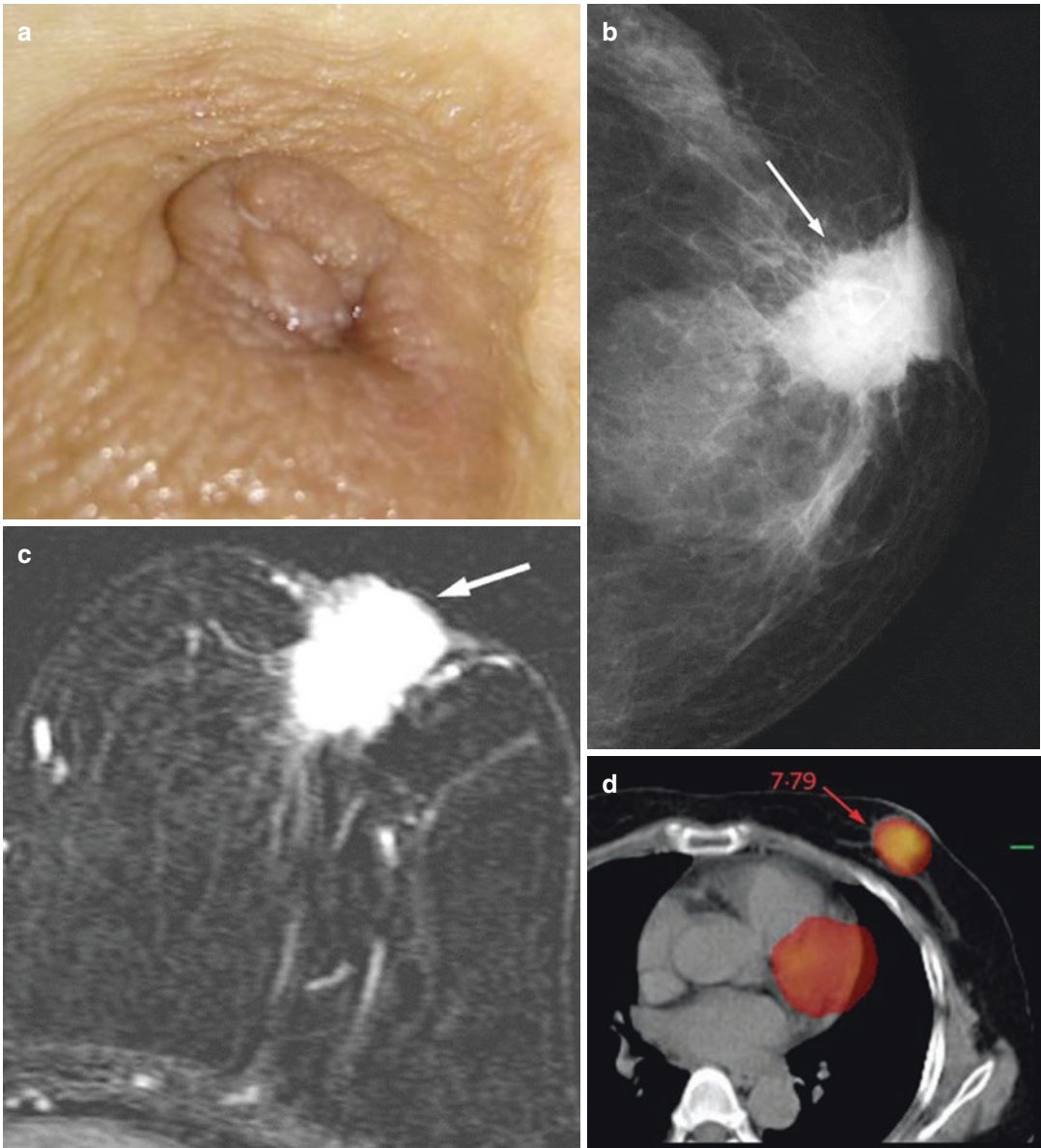


Fig. 8.13 Invasive ductal carcinoma in a 61-year-old woman. (a) Retracted nipple. (b) Left craniocaudal mammogram showing a large irregularly shaped dense subareolar mass (*arrow*) with speculated margin and associated nipple retraction. (c) Axial contrast-enhanced subtraction MRI showing a large irregularly shaped spec-

ulated subareolar mass extending to the nipple (*arrow*). (d) Positron emission tomogram showing a hypermetabolic subareolar mass (*arrow*; maximum standardized uptake value, 7.79) in the left breast. (e) Mastectomy specimen showing invasive ductal carcinoma (hematoxylin-eosin, original magnification $\times 200$)

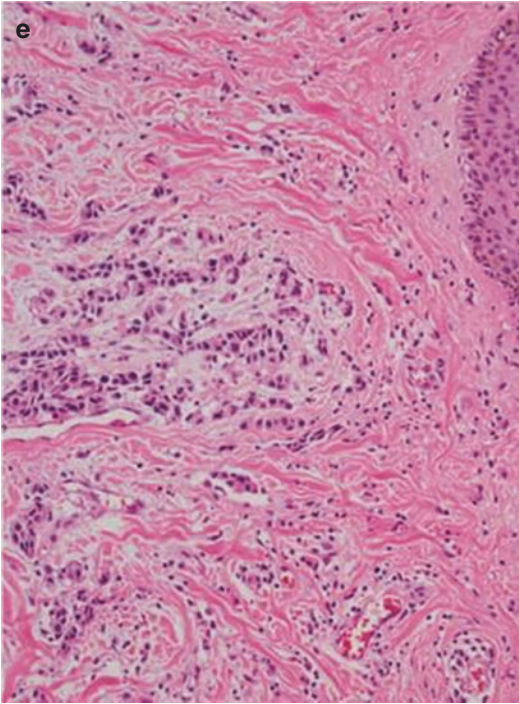


Fig. 8.13 (continued)

Conclusions

The nipple-areolar complex is affected by various diseases, which have unique and various clinical findings of this region of the breast. Clinical history and physical examination are most particularly important, and a tailored image evaluation with multiple modalities often is necessary to accurately diagnose an underlying abnormality of the nipple-areolar complex.

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