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Techniques in Vascular and Interventional Radiology

Mammography and Breast Localization for the Interventionalist

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The goal of any physician practicing breast imaging and interventions is to identify breast cancers at their earliest so as to best affect patient outcomes. As screening mammography is the most widely used diagnostic tool in the detection of breast cancer, a thorough understanding of mammography and potential benign and malignant findings are a core requirement for breast imagers and interventionalists. Once identified, tumors must be surgically removed. Mammographic guided breast needle localization is a basic yet essential and very important procedure to facilitate proper surgical removal of breast cancer with a high degree of accuracy and lowest possible patient morbidity.
Tech Vasc Interventional Rad 17:10-15

KEYWORDS Mammography, Breast lesion, preoperative localization

Basics of Mammography

Breast compression and positioning are major considerations for obtaining higher-quality mammograms. Properly applied compression is one of the most neglected and most important factors affecting image quality in mammography. A primary goal of compression is to uniformly reduce thickness of the breast so it is more readily and evenly penetrated by the x-ray beam from the subcutaneous region to the chest wall. Without the compression of the tissues, the image is less clear and does not provide the same level of information. Advantages of adequate breast compression are to reduce geometric unsharpness by bringing the object closer to the detector, improve contrast by reducing scatter and enabling use of a lower kVp beam, diminish motion artifact by permitting shorter exposure times and immobilizing the breast, and reduce radiation dose by decreasing the thickness of breast tissue that needs to be penetrated. To achieve more uniform density, a homogeneous breast thickness prevents overpenetration of the thinner anterior breast tissues and underpenetration of the thicker posterior breast tissues. Adequate compression provides a more accurate assessment of the density of masses as normal glandular tissues are more easily compressed and denser masses are highlighted.

To separate superimposed breast tissues so that lesions are better seen, correct positioning is an important factor in evaluating clinical images. During a routine mammogram, each of the breasts is imaged separately with 2 different views of each breast. Each view shows somewhat different details and territory. The basic views are the craniocaudal (CC) view—from above a horizontally compressed breast (Fig. 1A) and the mediolateral (ML)-oblique—from the side and at an angle of a diagonally compressed breast (Fig. 1B). Other views may be taken for a diagnostic purposes including lateromedial—from the outside toward the center; ML—from the center toward the outside; spot compression—compression on only a small area to get more detail (Fig. 1C); cleavage view—both breasts compressed, to see tissue nearest center of chest; and magnification—to see borders of structures and calcifications (Fig. 2).

The Different Types of Breast Tissue

The radiographic appearance of the breast on mammography varies among women and reflects variations in breast tissue composition and the different x-ray attenuation characteristics of these tissues. Fat is radiologically lucent and appears dark on a mammogram. Connective and epithelial tissues are radiologically dense and appear

The research was supported by research funds that comes from the research of "National Key Basic Research Program of China" (2014CB744504).

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 1089-2516/14/$ - see front matter
http://dx.doi.org/10.1053/j.tvir.2013.12.003

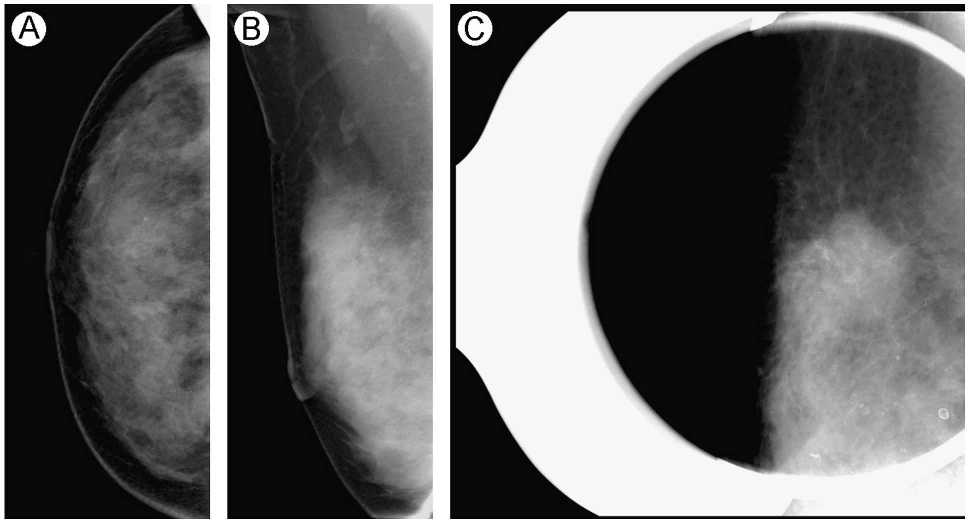

Figure 1 A 46-year-old woman with invasive ductal carcinoma in the upper outer quadrant of the right breast. The mass is not well shown in CC view (A) and MLO view (B) because of surrounding dense parenchyma. The mass with calcification is clearly shown in the spot compression (C), and we get more detail of the mass. MLO, mediolateral-oblique.

light. These variations in appearance are commonly described as the percentage of the breast image that is radiologically dense or as percent mammographic density. The percent mammographic density is a strong and consistent risk factor for breast cancer.[1] Women with dense tissue occupying more than 60%-75% of the breast are at 3-6 times greater risk of breast cancer than women with little or no dense tissue.[2] Breast density is inversely associated with age, parity, and weight and is reduced by menopause and by tamoxifen.

To date, 5 principal methods have been used to assess mammographic density. Wolfe[3] described 4 categories of breast density: N1 (predominately fat), P1 and P2 (ductal prominence in "less than one-fourth or more than one-fourth," respectively, of the breast), and DY (extensive "dysplasia"). The American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) also has categories of mammographic breast density from 1-4. Other methods include visual estimation of the proportion of the breast occupied by radiologically dense breast tissue,[4] planimetry,[5] and computer-assisted methods of measurement that are based on interactive thresholding.[6]

The Wolfe categories have largely been replaced in the literature by quantitative methods of classification or by the BI-RADS score. The classification method of BI-RADS has 4 categories of mammographic breast density.[7]

ACR 1: breast tissue that is almost entirely fat (<25% glandular),

ACR 2: breast tissue that has scattered fibroglandular density (25%-50% glandular),

ACR 3: breast tissue that has heterogeneous density (51%-75% glandular),

ACR 4: breast tissue that is extremely dense (>75% glandular).

It is very easy to locate the lesion for breast composition type 1 (Fig. 3A and B). It is much more difficult to analyze

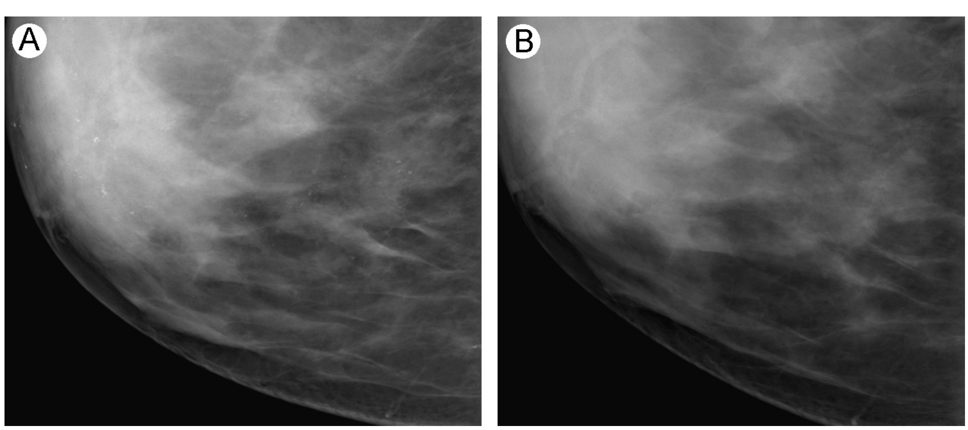

Figure 2 A 36-year-old woman with the artifact due to residue of plaster. Residue of plaster can be seen in the inner quadrant of the right breast (A). It is similar to microcalcification. After cleaning with water, the residue of plaster disappears (B).