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종 설

Imaging After Oncoplastic Breast Surgery

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Imaging findings after oncoplastic breast surgery are different from findings after conventional breast cancer surgery. Breast images can be difficult to interpret due to alteration of anatomy and post-operative changes in unexpected location. Understanding the changes after oncoplastic breast surgery can help understanding the imaging findings and detecting recurrence on follow up images after the surgery. In this review, common findings after breast conserving surgery or mastectomy with oncoplastic surgery, findings of complications after surgery and recurrence are discussed.

Index words: Breast cancer; Oncoplastic surgery; Breast conserving surgery; Acellular dermal matrix; Breast reconstruction

Introduction

In breast cancer surgery, removing large volume and leaving minimal residual breast tissue decreases the risk of local recurrence. However, it causes visible deformity and decreases the quality of life after surgery in breast cancer patients. For these reasons, cancer surgery with plastic surgery techniques to achieve better cosmetic outcomes for women undergoing breast cancer surgery is increasingly being recognized as an important component of breast cancer treatment (1, 2). Oncoplastic surgery techniques allow more tissue to be removed while still achieving a good cosmetic outcome. And it is not only considered in mastectomy but also in breast conserving surgery (BCS) by volume replacement or volume displacement (3, 4).

After breast cancer surgery, radiological examinations including mammography, breast ultrasound (US), and breast MRI are performed for postoperative surveillance. As oncoplastic surgery increases in breast cancer surgery, the findings seen in postoperative breast images are also changing from those seen after conventional breast cancer surgery. Altered breast anatomy and scars in unexpected location make it more difficult for radiologists to detect abnormalities and interpret imaging findings. To identify recurrence after surgery in postoperative follow up images,

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radiologists should be aware of the findings after oncoplastic surgery.

In this review article, common findings after BCS or mastectomy with oncoplastic surgery, findings of complications after surgery and recurrence will be discussed. I hope that this review will help readers become familiar with the imaging findings after breast oncoplastic surgery and find abnormalities.

Images after oncoplastic surgery with BCS

In conventional BCS, the breast tissue is undermined both from the skin and pectoralis muscle, and a full thickness of breast tissue including the tumor is resected. Then, the defect is simply repaired without volume replacement. On images, initially a tissue defect with postoperative fluid collection at operation site and surrounding edematous change in breast tissue are seen, and the fluid decreases over time remaining a scar. Sometimes, fluid collection is replaced by fibrous and granulation tissue resulting in a mass-like lesion at operation site. However, serial changes from the fluid collection to be decreased volume and increased internal echogenicity, layer of fibrous tissue, and no vascularity help the differentiation of scar from recurrent tumor.

Oncoplastic surgery after BCS can be performed using transposition or displacement of adjacent glandular or fat tissue, or using flap reconstruction according to the volume of removed tissue, followed by nipple reposition (4, 5). When the removed volume of tissue is small, glandular reshaping and local tissue displacement techniques are used for volume replacement. In cases where the defect is too large to be filled by local tissues, tissue replacement

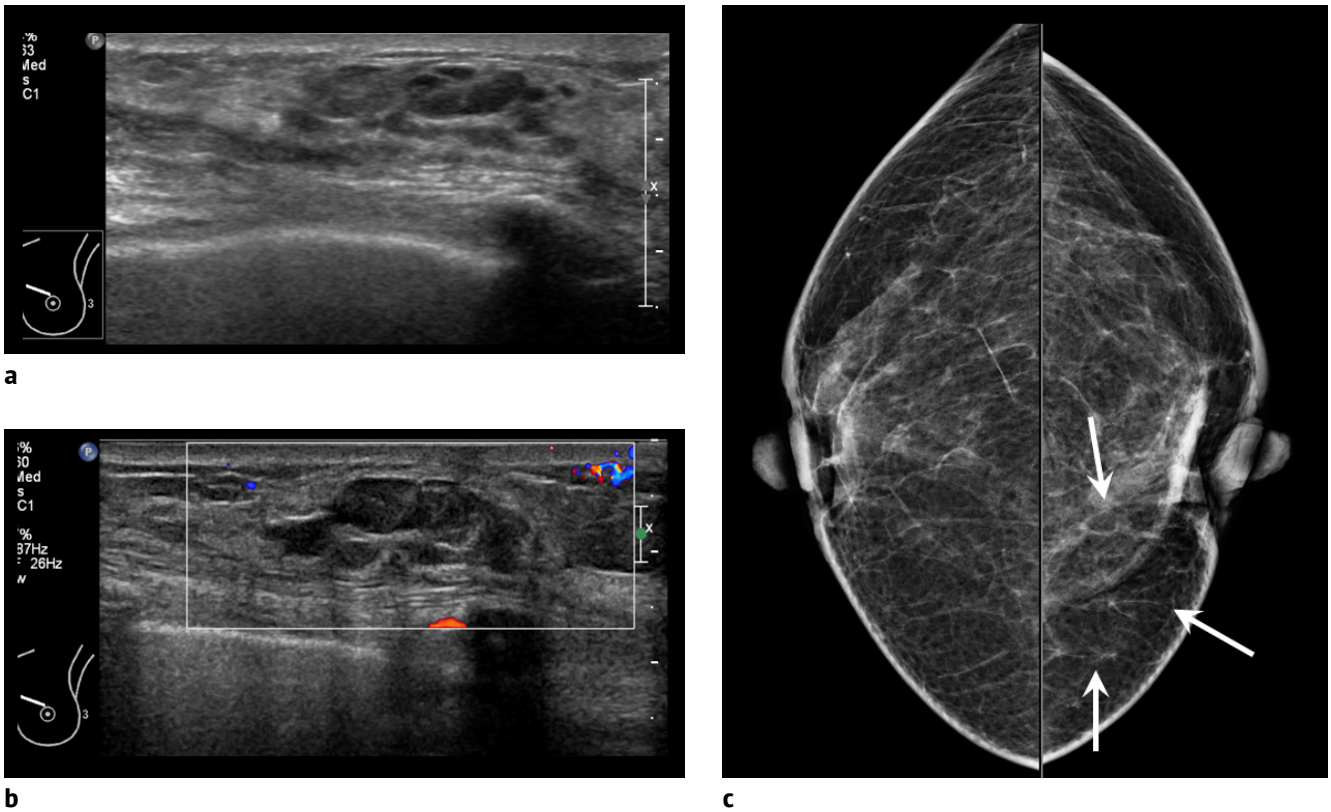


Fig. 1. A 57-year-old female patient who had left breast conserving surgery and volume replacement with transposed fat. Breast ultrasound shows an isoechoic mass at operation site (**a**) without vascularity on Doppler study (**b**). Mammography shows fat density (arrows) in operation site (**c**).

methods and local flaps such as latissimus dorsi (LD) myocutaneous flap, or perforator flaps may be employed. If these techniques are insufficient to fill the defect, the remaining breast tissue may be reshaped to a smaller size and rounder shape, and additional contralateral reduction mammoplasty may be required to achieve symmetry.

On images, scars between the subcutaneous fat tissue and breast parenchyma caused by dissection and displacement of breast tissue are widely observed in the breast separated from the surgical site. Postoperative fluid collection, cystic change, or fat necrosis can be seen along the scars away from the surgical site, too. When the transposed fat tissue fills the surgical defect of BCS, fat necrosis of the transposed fat may form a hard mass at the operation site. Some of them show associated calcifications on mammography and posterior shadowing on US. However, fat density of the mass on mammography and no vascularity within the mass with same echogenicity as subcutaneous fat help distinguishing the transposed fat tissue from recurrent breast cancer (Fig. 1). In the cases of flap reconstruction, a part of LD muscle with a variable subcutaneous component or a fasiocutaneous flap based on a chest wall perforator is mainly used in BCS patients. LD flap is well visible on mammography by radio-opaque muscle striations in upper outer portion of breast, however, no muscle density is seen in the case of chest wall perforator flap and only subcutaneous adipose tissue from the lateral chest wall making good volume and symmetric shape of operated breast is visible (6). Acellular dermal matrix (ADM) or synthetic mesh

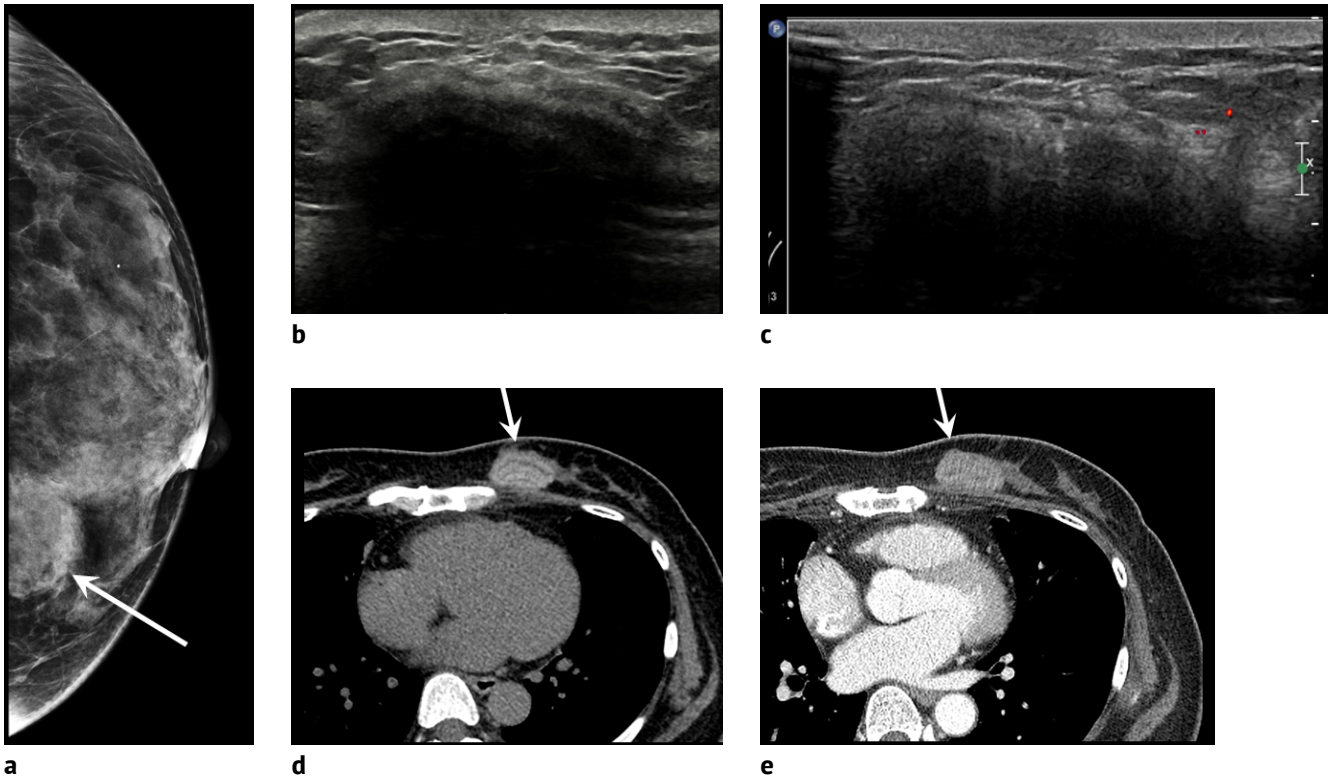


Fig. 2. A 48-year-old female patient who had left breast conserving surgery and volume replacement with acellular dermal matrix (ADM). On mammography, a hyperdense mass (arrow) is seen in left lower inner breast, operation site (**a**). Ultrasound shows a hyperechoic mass with posterior shadowing (**b**) in operation site and no vascularity within the mass on Doppler study (**c**). Pre (**d**)- and post (**e**)-contrast enhanced chest CT show a circumscribed high-density mass without contrast-enhancement (arrows). Folded or layered appearance of ADM is seen on both ultrasound and CT scan.

can be also used to fill the surgical defect of BCS (7). In those cases, hyperdense mass density is seen on mammography mimicking recurrent tumor. However, US can differentiate ADM or mesh which shows a mass-forming echogenic foreign body materials with rolled appearance or multiple cube-like appearance without vascularity, from recurrent breast cancer (Fig. 2). Non-enhancing mass-like volume replacing material with low signal intensity on fat suppressed images can be seen on breast MRI (8).

Images after oncoplastic surgery with mastectomy

US after conventional total mastectomy (TM) usually shows a very thin, almost invisible, layer of remnant subcutaneous fat tissue covering the chest wall muscle and skin layer. Recently various alternatives to simple mastectomy are implemented including skin-sparing mastectomy (SSM) or nipple-sparing mastectomy (NSM) with or without simultaneous reduction of skin envelope or free nipple grafting (9). In the cases of SSM, subcutaneous fat layer is usually thicker than TM on US or MRI, and nipple with minimal retroareolar breast tissue is visible in NSM cases. Mammography is not implemented as a routine examination for postoperative follow up after NSM.

For correcting the post mastectomy defects, implant-based reconstruction is most commonly used and flap reconstruction follows after it. In the past, usually 2-stage reconstruction was performed, with tissue expander insertion followed by expansion and implant exchange. Recently, direct-to-implant (DTI) reconstruction is increasing for volume replacement after mastectomy (10). In the case of 2-stage reconstruction with tissue expander

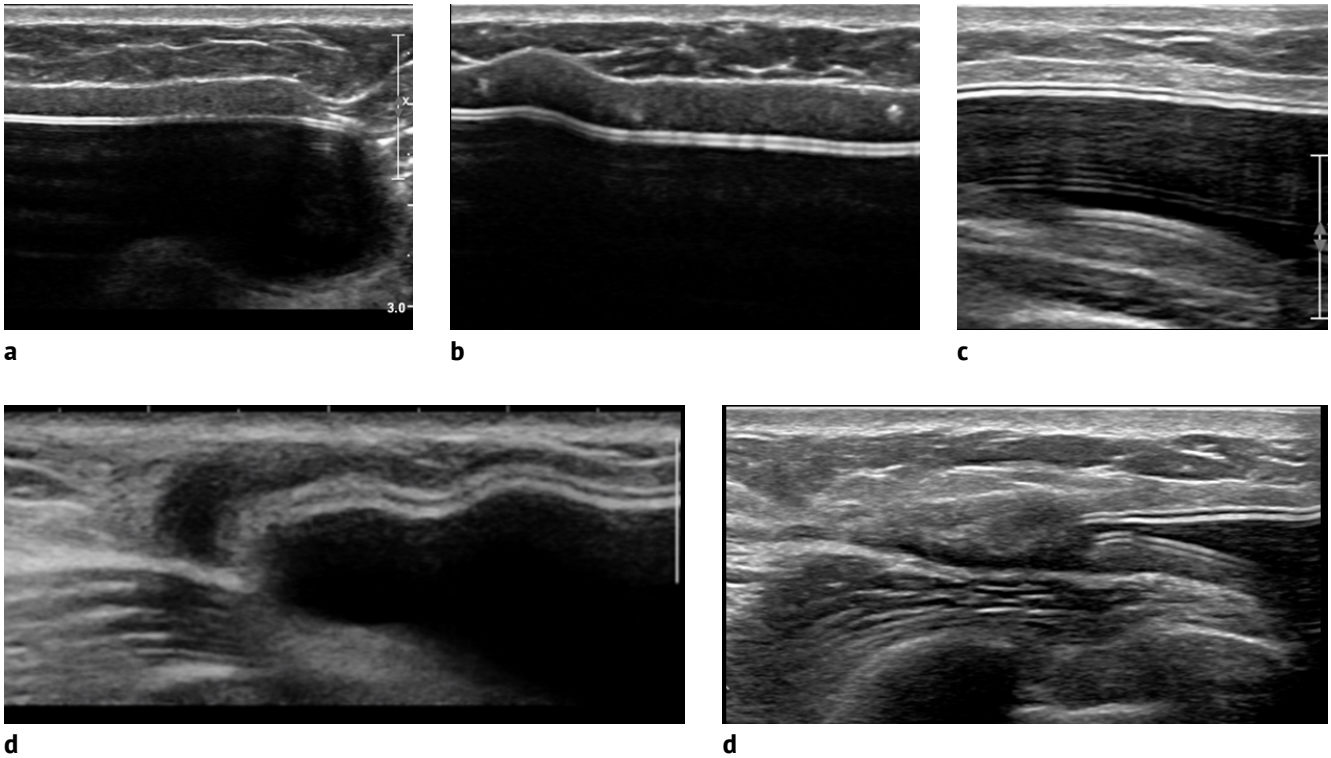


Fig. 3. Prepectoral implants with acellular dermal matrix (ADM) after skin-sparing mastectomy. ADM covering the surface of implant shows a thick band-like appearance on US (**a**). Over time, echogenic spots appear within the ADM (**b**), and ADM becomes thin and heterogeneously hyperechoic (**c**), or irregular in thickness (**d**). ADM folded at the margin of the implant can look like a mass (**e**).

insertion, US is the only modality to evaluate operation bed during the tissue expander period. Because of the magnet in the valve of the tissue expander, MRI cannot be taken. The large valve of tissue expander seen in US and partially folded tissue expander that is not fully extended should not be misunderstood as an implant rupture. In the case of DTI, prepectoral implant insertion has risen with use of ADM or synthetic mesh. They are used as interface between the implant and the mastectomy flaps to help support and protect the implant, and to prevent capsular contracture (10). ADM covering the surface of implant can be seen as a thick band-like structure on US. Over time, ADM becomes irregular in thickness and shows echogenic spots and heterogeneous hyperechogenicity inside (Fig. 3) (11).

Breast reconstruction using autologous flap after mastectomy was either LD or transverse rectus abdominis myocutaneous (TRAM) flap reconstruction for a long time. Images after LD or TRAM flap reconstruction show double layers of muscles and fat tissue in operation bed. As the use of perforator flap has increased, only additional layer of fat tissue without muscle is seen (9). Especially, deep inferior epigastric perforator (DIEP) flap, the most commonly used flap, usually has a very rich fat thickness, so it looks like a large fatty mass replacing the mastectomy defect between the pectoralis muscle and skin. Occasionally, fat necrosis occurs along the boundary of flap, which appears to be echogenic lesion on US or enhancing

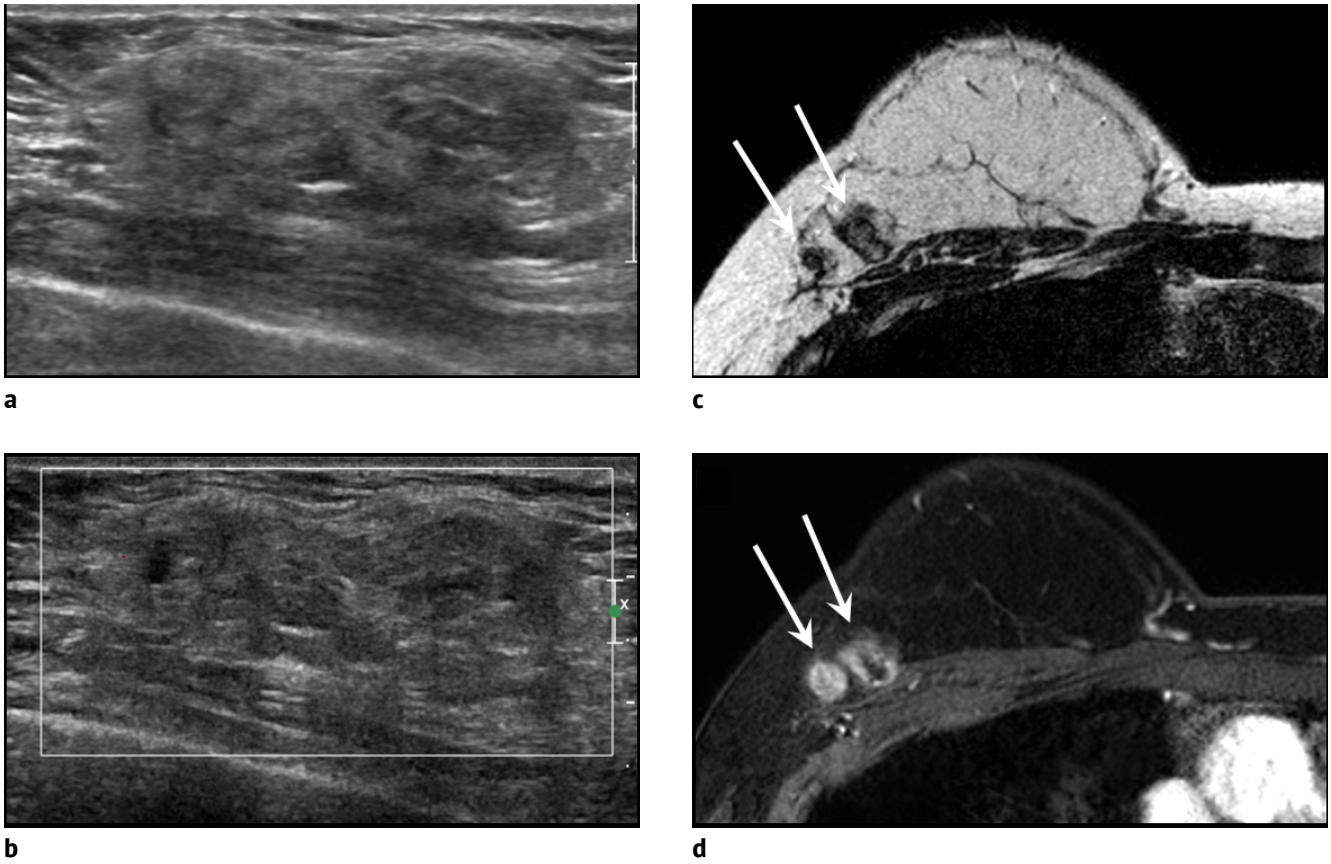
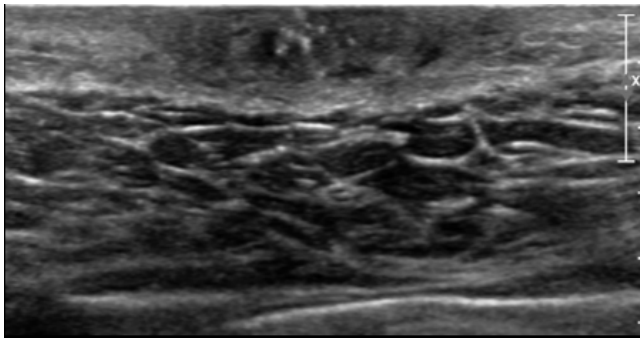


Fig. 4. A 44-year-old female patient who had right skin-sparing mastectomy and DIEP free flap reconstruction. On postoperative screening ultrasound, heterogeneous hyperechoic masses are seen along the upper outer margin of the flap (**a**) without internal vascularity on Doppler study (**b**). T1-weighted axial scan of breast MRI shows corresponding masses with internal fat signal intensity (arrows) (**c**) and contrast-enhanced fat-suppressed scan shows rim enhancement and fat suppression in the center of the masses (arrows) suggesting fat necrosis (**d**).

mass on MRI (Fig. 4). However, fat density within the mass on mammography can confirm that it is fat necrosis.

Images of recurrence after breast oncoplastic surgery

Oncoplastic surgery after BCS makes displacement of breast tissue, altered anatomy, and widely spread scars. Therefore, it is more challenging to detect early recurrence on postoperative mammography or US than conventional BCS with postoperative changes. However, like in follow up images after conventional BCS, new density or suspicious calcifications on mammography could be considered suspicious. On US, suspicious changes in the shape



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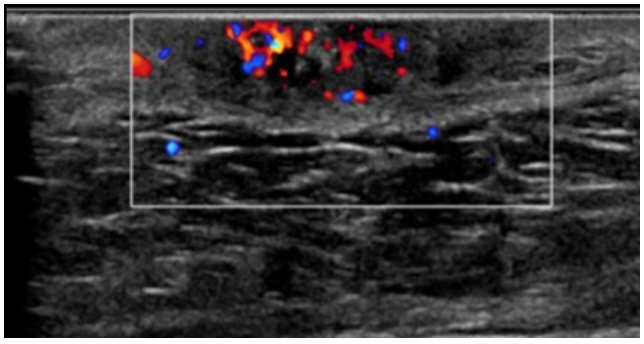

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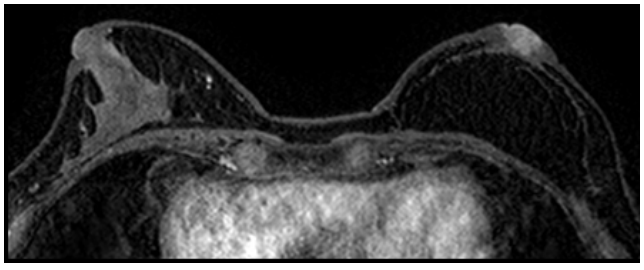

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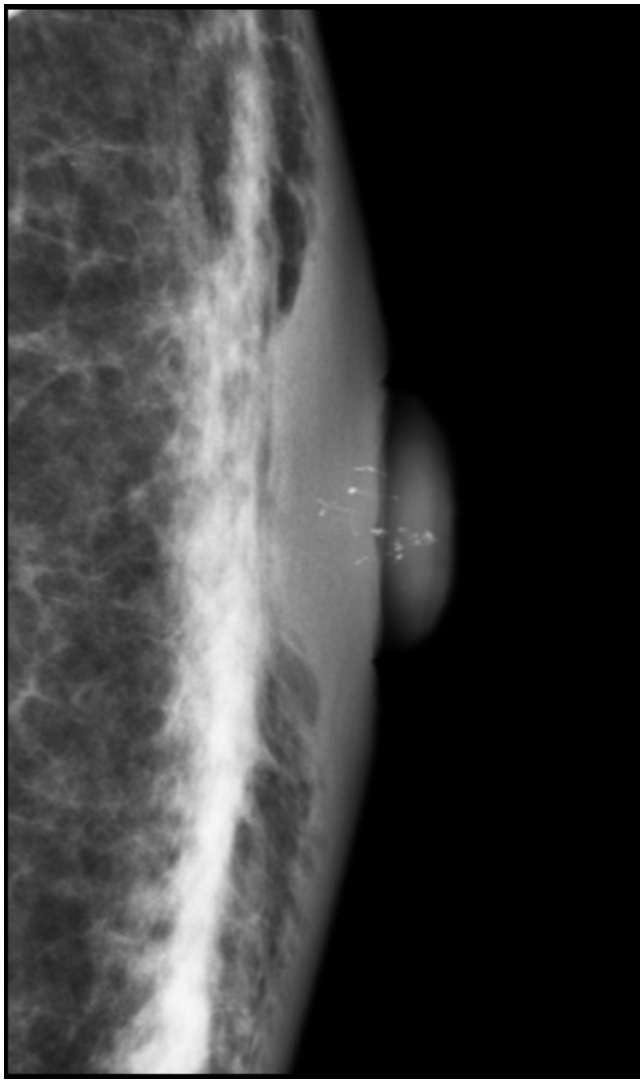

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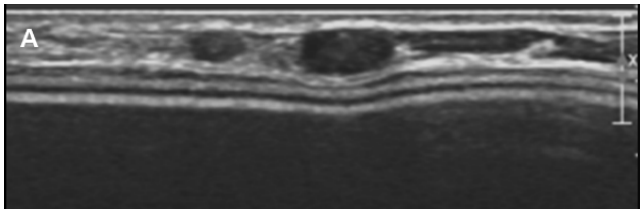
Fig. 5. A 56-year-old female patient who had left nipple-sparing mastectomy and DIEP free flap reconstruction. On postoperative screening ultrasound for the mastectomy site, left nipple seems to be enlarged and shows heterogeneous echogenicity with internal echogenic dots suggesting calcifications (**a**). Doppler ultrasound shows increased vascularity within the nipple (**b**). On contrast-enhanced, fat-suppressed scan of breast MRI, left nipple shows asymmetric enhancement compared with right side (**c**). Mammography of left breast shows newly developed fine linear microcalcifications within the nipple and subareolar area (**d**). Punch biopsy and subsequent excision revealed recurrent ductal carcinoma in situ with Paget's disease.



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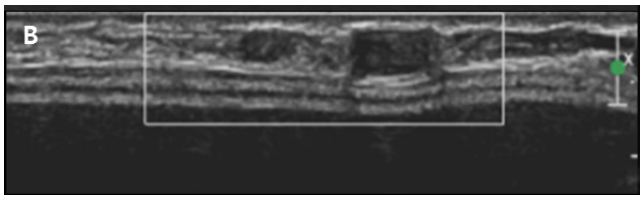

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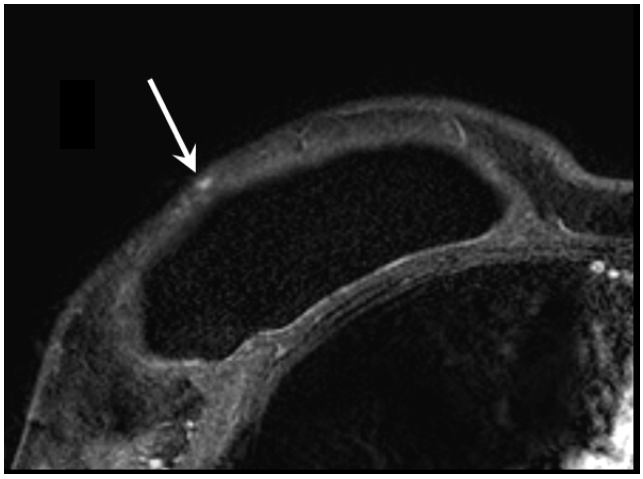
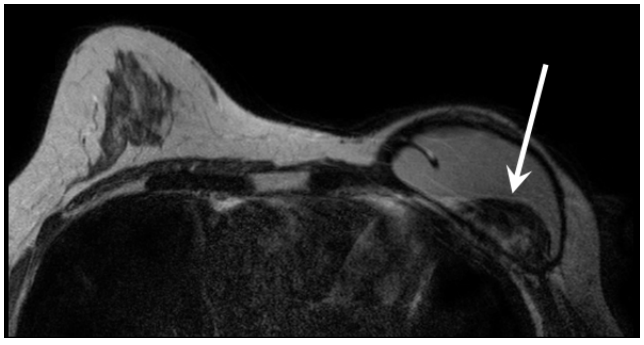


c

Fig. 6. A 50-year-old female patient who had right nipple-sparing mastectomy and implant insertion. One and a half years after the surgery, 0.6 cm and 0.3 cm sized two circumscribed isoechoic masses were noted on the screening breast ultrasound (**a**), with no vascularity on Doppler study (**b**). Benign nodules were suggested and final assessment of breast ultrasound was BI-RADS category 3. Because the nodules were new and palpable, fine needle aspiration was performed, and the histology was metastatic carcinoma. Breast MRI shows a tiny nodular enhancement (arrow) in that area corresponding to the 0.6 cm nodule (**c**).



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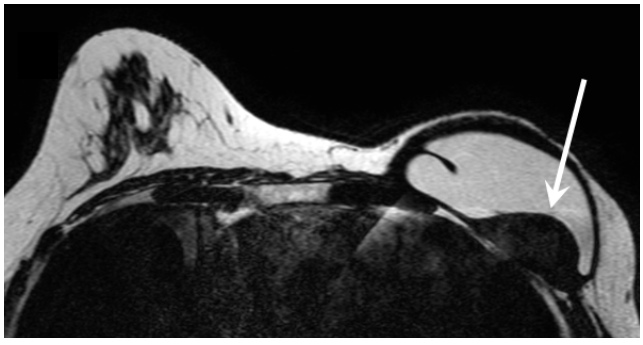

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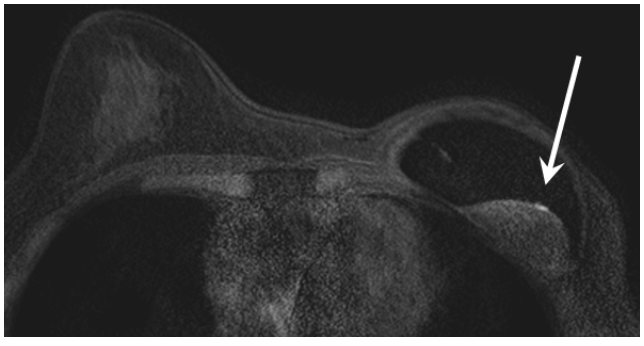

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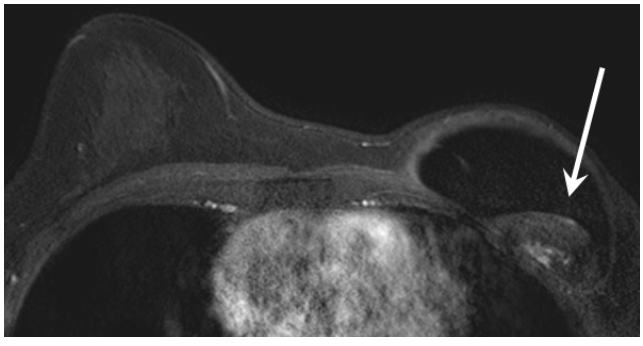

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Fig. 7. A 45-year-old female patient who had left mastectomy with implant insertion. On screening breast MRI, there is a 5 cm mass that protrudes into the implant in the poster aspect of the implant. The mass (arrows) shows internal high signal intensity on T2-weight image (**a**) and low signal intensity on T1-weighted image (**b**). Pre (**c**)- and post (**d**)-contrast enhanced images with fat suppression show heterogeneous enhancement within the mass (arrows). The implant was removed and intracapsular hematoma was diagnosed.

of operation scar or new findings around the scar should be carefully examined with the possibility of recurrence in mind.

In oncoplastic surgery after mastectomy, screening mammography for the mastectomy site with reconstruction is not recommended (12). The cancer detection rate of screening mammography in mastectomy with autologous flap reconstruction site is as low as 1.5/1000 and showed no benefit over physical examination (13). However, mammography can be performed if necessary for the mastectomy with reconstruction site (Fig. 5). However, Although, breast US is most commonly used modality for evaluating mastectomy bed with reconstruction, MRI is the most sensitive modality that shows recurrence (14). However, some lesions like fat necrosis can show suspicious enhancing mass on MRI but typical benign finding on mammography, it is necessary to assess the abnormal findings by integrating the findings seen in all modalities. Any new lesions between the implant and skin, or within the remained tissue should be considered to have the possibility of recurrence (Fig. 6). Lesions inside the implant or within the flap are usually benign non-neoplastic lesions rather than recurrent tumor (Fig. 7) (15).

Conclusion

Interpreting breast images after oncoplastic breast surgery is a challenging thing. However, understanding the anatomical changes and knowing the imaging findings after the surgery can help detecting early recurrence and avoiding unnecessary biopsy.

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