# Digital Breast Tomosynthesis Findings after Surgical Lipomodeling in a Breast Cancer Survivor

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ABSTRACT

Autologous fat grafting or lipomodeling is a newly-adopted technique that is gaining increasing popularity in the treatment of contour deformities following breast conservation therapy. Here, we describe the case of a 47-year-old woman with a prior history of breast cancer treated with a lumpectomy and radiation therapy. She underwent lipomodeling not only of her treated breast but also of the contralateral breast. She presented for her annual mammogram which was performed with digital breast tomosynthesis. On imaging, a space-occupying lesion of mixed density was seen, expanding the lumpectomy site. There was also subtle distortion in the contralateral, non-treated breast. This case aims to highlight the mammographic and tomosynthesis findings seen following lipomodeling that may present diagnostic challenges in this patient population.





## CASE REPORT

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A 47 year old woman presented to our department for her annual surveillance mammogram following lumpectomy and radiation therapy of the right breast. A combination mode of 2-D digital mammography with tomosynthesis was performed (Hologic, Bedford, MA). Figures 1, 2 and 3 show the craniocaudal mammographic views, the mediolateral mammographic views and representative tomosynthesis slices, respectively. The patient had a prior history of a right breast triple-negative, node-positive invasive ductal carcinoma with ductal carcinoma in situ (DCIS). Following diagnosis in 2002, the patient was treated with a lumpectomy with axillary node dissection, radiation therapy and eight courses of chemotherapy. She has been in remission for 10 years and is currently followed by the cancer survivorship program at our institution for oncologic surveillance.

Earlier in the year, the patient underwent autologous fat transfer to both breasts to correct treatment-induced right breast contractures and left breast ptosis. The corrective surgery consisted of bilateral large volume fat grafting where a two-liter liposuction was performed with 350 ml of the grafted fat infiltrated in the right breast and 265 ml infiltrated in the left breast. A left vertical wedge mastopexy was also undertaken at that time.

*Imaging Findings*

On mammographic imaging, the left and right breasts were heterogeneously dense. Images of the right breast revealed post-surgical changes consistent with the history of a right lumpectomy with axillary nodal dissection. Comparison to prior studies revealed a new 9.4x10 cm mixed density, space-occupying lesion in the central and inferior breast. The surgical clips showed spreading or separation compared with earlier imaging consistent with increasing volume within this portion of the breast. Tomosynthesis imaging better demonstrated the mixed density area in the lower portion of the breast with the area clearly seen as fat containing. This appearance is consistent with the history of lipoinjection. Similarly, 2-D mammographic images of the left breast revealed a space-occupying lesion of low density in the posterior breast. However, fat containing areas in the inferior posterior breast consistent with lipoinjection were better visualized on tomosynthesis imaging.

*Management and Follow-up*

No suspicious findings were seen in either breasts and routine yearly follow-up was recommended.

## DISCUSSION

*Demographics and Etiology*

Autologous fat grafting or lipomodeling is a widely used technique for soft tissue augmentation [1-4]. Yet, its implementation in the breast has been controversial. In 1987, the American Society of Plastic Surgeons (ASPS) issued a statement banning its use because of concerns regarding unknown carcinogenic risks and its associated radiologic changes, which were felt to possibly hamper mammographic cancer screening and surveillance [5, 6]. However, over the past decade, a number of studies emerged from Europe providing evidence that the concerns of the transplanted fat hindering breast imaging interpretation or posing safety risks to patients were largely unfounded [7-10]. In 2009, the ASPS revised its position on this technique. Their policy now states that there appears to be no major interference with breast cancer detection but calls for more studies to confirm these findings [11].

Over the last few years and with the changing position of the ASPS regarding this technique, autologous fat grafting of the breast has been gaining increasing popularity in women with breast deformities due to its ease of use, low morbidity and the excellent reported fat graft survival durations [12]. The procedure consists of three distinct stages: 1) adipose tissue harvest from the lateral thigh or flank, 2) purification by gravity separation and 3) transplantation of the harvested fat along different planes of the breast [7]. This technique has proven particularly useful in breast cancer survivors in the setting of correcting secondary contour deformities of the reconstructed breast by providing a natural filler to replace subcutaneous tissue removed during lumpectomy. A summary of the clinical characteristics of patients typically undergoing this procedure is presented in table 1.

*Prognosis and Treatment*

Available studies report excellent fat graft survival durations of at least 7 years or longer [12]. However, in the case of limited graft survival, the treatment of choice is surgical revision where the procedure can be repeated to improve the cosmetic outcome.

*Clinical and Imaging Findings*

Thus far, the concerns surrounding the use of autologous fat grafting in the breast and the possibility that the intervention might hinder cancer detection in the post-lipomodeling breast have not been founded. However, transplanted adipose tissue can undergo fat necrosis inducing tissue changes that may mimic malignancy such as the early calcific changes seen in fat necrosis. In the patient presented, the transplanted fat graft manifested as a space-occupying lesion that led to clip spreading in the patient's lumpectomy site.

Digital breast tomosynthesis is an evolving mammographic technique that allows 3D evaluation of the breast, therefore, reducing the effect of overlapping breast tissue. Early data has shown that tomosynthesis imaging combined with conventional 2D mammography improves the specificity of diagnostic imaging without a loss of sensitivity [13]. In this patient, the typical findings of lipomodeling were much more conspicuous on tomosynthesis imaging than on 2-D mammographic imaging. In the non-treated breast, subtle distortion seen on the 2-D imaging was clearly due to fat grafting and mastopexy on tomosynthesis imaging. While we did not observe calcifications of fat necrosis, such changes remain a possibility as we continue to follow this patient.

*Differential Diagnoses*

In the post-lipomodeling breast, the differential for areas of clinical concern typically includes malignancy or post-surgical changes such as fat necrosis or fibrosis (table 2). Hamartomas might also present with a similar appearance. Mammographically, cancers present as irregular masses or focal asymmetries with or without suspicious calcifications and with or without architectural distortion. In the early phases of benign fat necrosis, indeterminate calcifications may be seen, sometime prompting biopsy. When available, tomosynthesis may allow better visualization of the combination of fat density (lucency) and post-surgical change by reducing tissue overlap. A number of studies have assessed the mammographic appearance of the breast post-autologous fat transplantation. In one study conducted in a cohort of 31 patients that underwent this procedure, the authors reported microcalcifications in 5 patients, macrocalcifications in 3 patients, oil cysts in 8 patients, and 4 cases with architectural distortion characterized by well-circumscribed areas of variable tissue density [14]. In another study that included 30 patients, the authors reported 14 cases that exhibited fat changes, 4 patients with benign calcification and 1 patient that required a biopsy for suspicious changes [15].

*Challenges and Future Directions*

While encouraging, the data on the effect of autologous fat transplant on image interpretation in the setting of cancer surveillance remains limited. Larger studies are warranted and digital breast tomosynthesis may make the post-intervention findings more conspicuous. While tomosynthesis might be of limited value in distinguishing pleomorphic calcifications of tumor recurrence from early dystrophic calcifications seen with benign fat necrosis, tomosynthesis provides the advantage of in-plane visualization of breast structures with reduced tissue overlap. We see tomosynthesis as playing a complementary role to mammography in this setting. Tomosynthesis can provide improved visualization of implanted fat after lipomodeling due to the in-plane imaging of the low density fat. With 2-D imaging alone, superimposed dense glandular regions may obscure the fatty areas making the differentiation between post-surgical changes and new or recurrent malignancies difficult.

In conclusion, with the increasing use of autologous fat grafting in breast cancer survivors, radiologists should acquire a thorough knowledge of the imaging changes that follow this procedure. We also recommend performing pre- and post-

lipomodeling imaging to re-establish a baseline for patients undergoing this procedure. With available studies reporting new radiographic findings in nearly 50% of post-lipomodeling mammograms, radiologists should be familiar with this procedure and recognize its associated mammographic appearance. If an area of clinical concern is identified, distinguishing fat changes from malignancies in the setting of lipomodeling can present a challenge and tomosynthesis imaging may be helpful to help distinguish benign from malignant findings.

## TEACHING POINT

Autologous fat transplantation of the breast is becoming an increasingly used technique to correct contour deformities in breast cancer patients. Radiologists should include lipomodeling on their differential for space-occupying lesions in breast cancer survivors and should recognize the mammographic and tomosynthesis changes that accompany this procedure.

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FIGURES

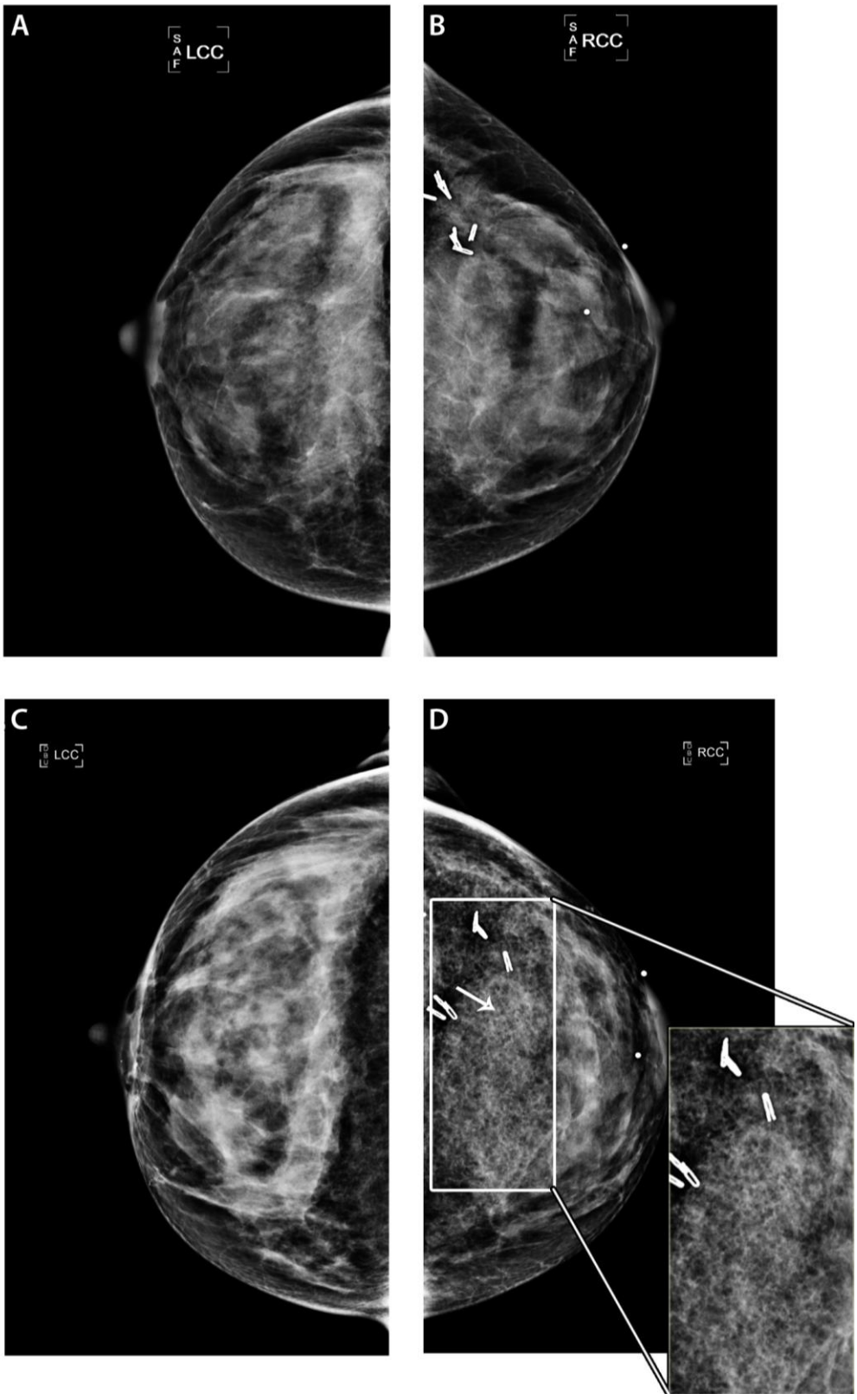


**Figure 1:** 47 year-old woman pre- and post- autologous fat grafting of the right and left breasts. Shown are craniocaudal mammographic images of both breasts. A and B correspond to the images of the left and right breasts respectively pre-lipmodeling. C and D correspond to the left and right breasts respectively post-lipomodeling. FINDINGS: In figure D, a 10x4.7 cm asymmetry of mixed density is seen in the posterior and central breast (see arrow). Also, note that there is spreading of the clips consistent with a space-occupying lesion in the surgical bed, when compared to figure B from 2 year prior. Corresponding findings are indicated with an arrow in the above figure. A magnification of the area of interest in provided. TECHNIQUE: Digital mammography combined with a tomosynthesis acquisition using 15 low dose images across a 15 degree arc. Tomosynthesis reconstruction was performed at 1mm thickness. kVp ranging from 26-32; mAs ranging from 74-334. (Dimensions, Hologic, Inc. Bedford, Mass).

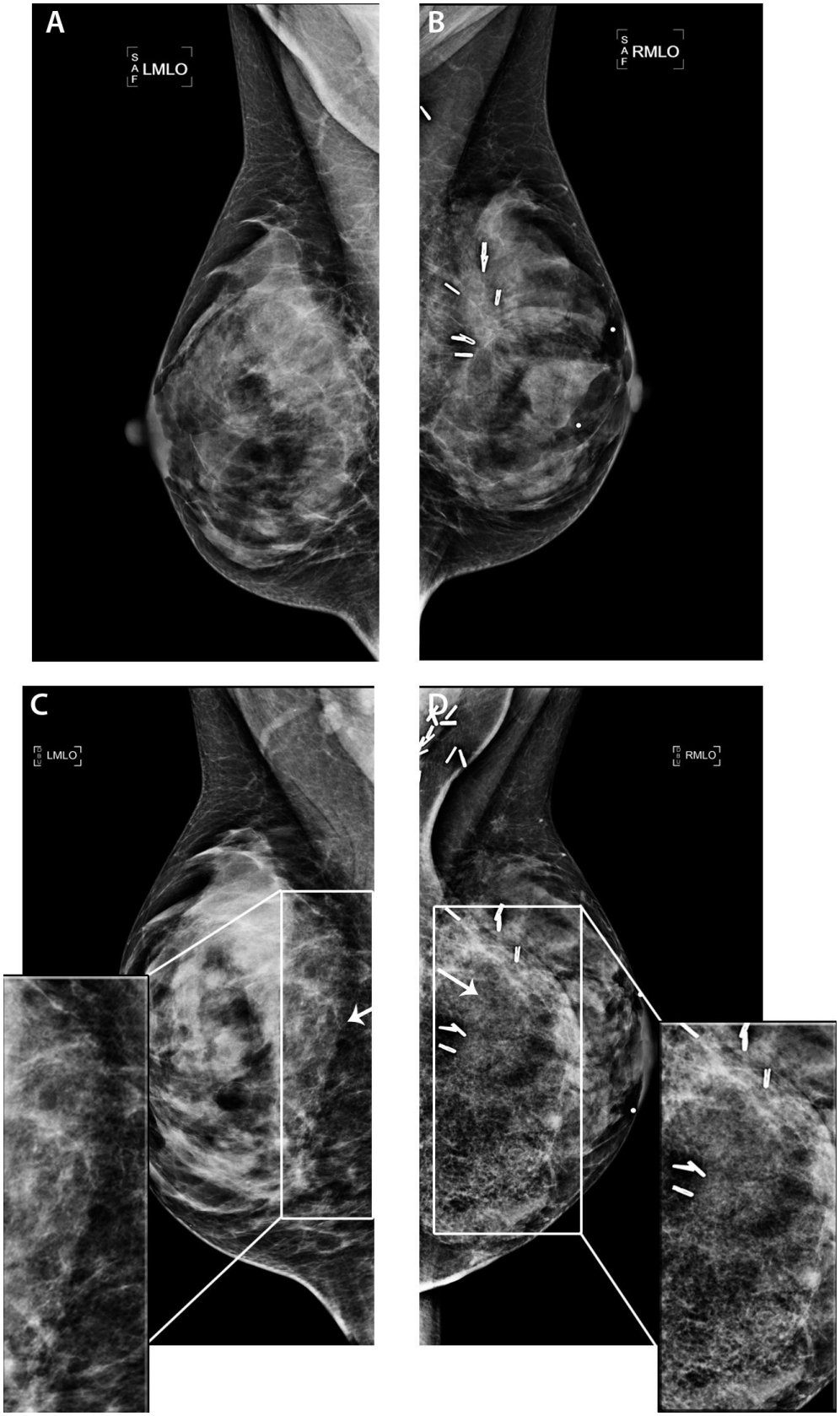


**Figure 2:** 47 year-old woman pre- and post- autologous fat grafting of the right and left breasts. Shown are mediolateral oblique mammographic images of both breasts. A and B correspond to the images of the left and right breasts respectively pre-lipmodeling. C and D correspond to the left and right breasts respectively post-lipomodeling. FINDINGS: In Image C, a new, well-circumscribed fat density mass (see arrow) is visible in the posterior portion of the breast compared to image A. In image D, a 9.4x10 cm area of mixed density is visible in the posterior and central breast (see arrow) as well as spreading of the clips consistent with a space-occupying lesion in the surgical bed when compared to the earlier image B. A magnification of the area of interest is also provided. TECHNIQUE: Digital mammography combined with a tomosynthesis acquisition using 15 low dose images across a 15 degree arc. Tomosynthesis reconstruction was performed at 1mm thickness. kVp ranging from 26-31; mAs ranging from 123-313. (Dimensions, Hologic, Inc. Bedford, Mass).

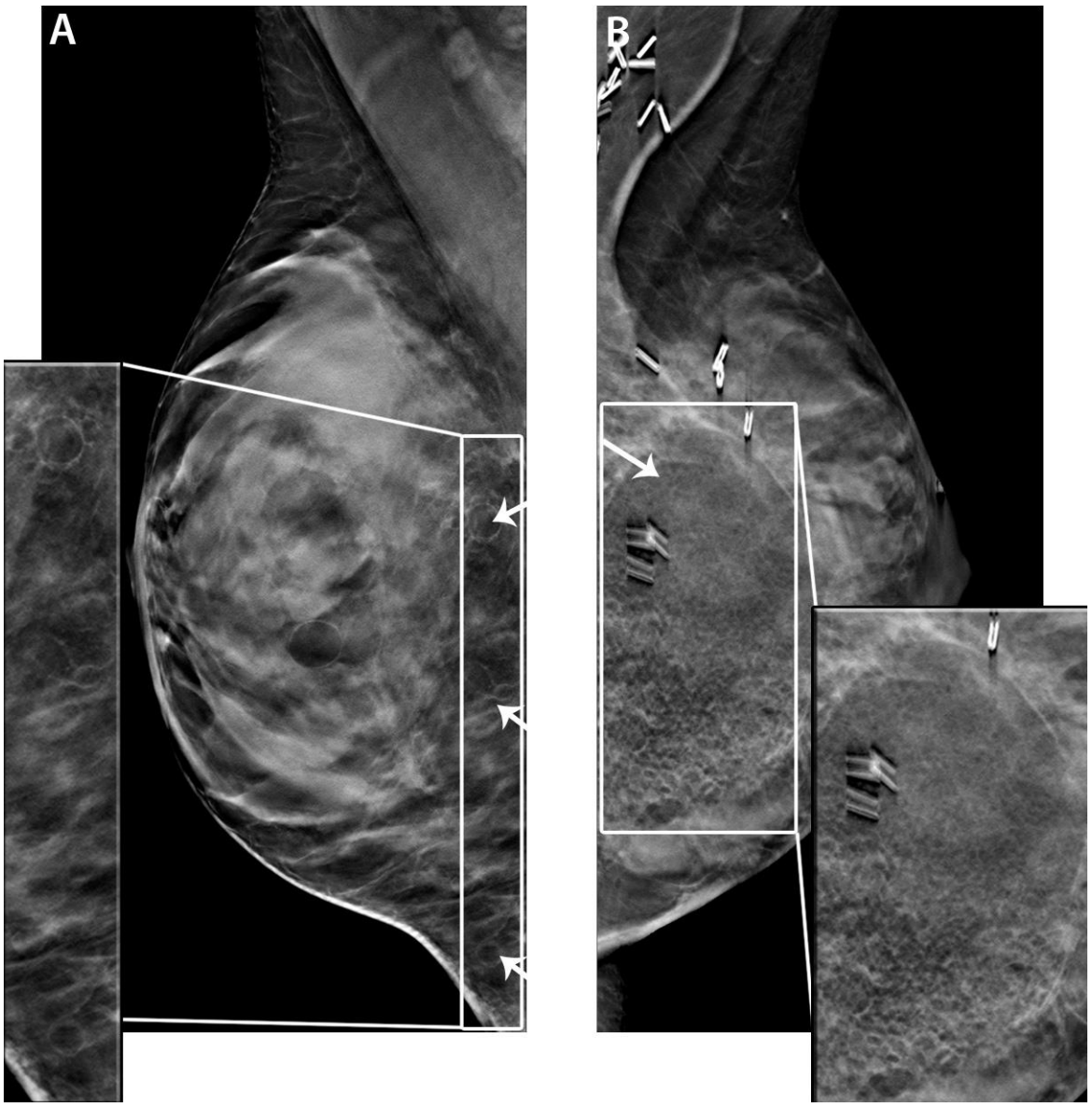


**Figure 3:** 47 year-old woman post-autologous fat grafting of the right and left breasts. Shown are representative mediolateral tomosynthesis slices of both breasts. Image A corresponds to the left breast and B corresponds to the right breast. FINDINGS: In the left breast, multiple fat density masses (see arrows) are present in the posterior breast consistent with multiple oil cysts. In the right breast a 9.4x10x4.7 cm space-occupying, well-circumscribed mass (see arrow) of mixed density is visible in the posterior and central breast. A magnification of the area of interest is provided. TECHNIQUE: Mediolateral digital breast tomosynthesis Digital mammography combined with a tomosynthesis acquisition using 15 low dose images across a 15 degree arc. Tomosynthesis reconstruction at 1mm thickness. kVp ranging from 26-31; mAs ranging from 123-313. (Dimensions, Hologic, Inc.Bedford, Mass.).

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|---|---|
| **Etiology** | Liposuction of adipose tissue from the patient's lateral flank/thigh followed by purification and reinjection in the patient's breast |
| **Incidence** | Technique drastically increasing in popularity for use in breast reconstruction procedures |
| **Gender Ratio** | Female patients |
| **Age Predilection** | Patients with history of breast cancer, predominantly post-menopausal |
| **Risk Factors** | History of breast cancer, breast reconstruction, desired cosmetic improvement of breast appearance |
| **Treatment** | Surgical revision if graft does not survive |
| **Prognosis** | Excellent prognosis with fat grafts reported to survive for long durations |
| **Findings on Imaging** | Space-occupying lesion of mixed density with possible fat necrosis changes such as oil cysts, macro- and micro-calcifications |

**Table 1:** Summary table of autologous fat grafting of the breast

| **Differential Diagnosis** | **Mammography/Tomosynthesis** |
|---|---|
| **Autologous fat grafting** | Mixed density asymmetry or mass with or without calcifications |
| **Neoplasm** | Asymmetry, mass or area of architectural distortion of equal or higher density compared to glandular tissue. Malignant lesions are frequently associated with suspicious calcifications |
| **Fat Necrosis** | Fat containing areas frequently associated with calcifications but often with associated distortion from prior surgery |
| **Hamartoma** | Well-circumscribed, mixed density mass containing both fat and glandular elements |

**Table 2:** Differential diagnosis table for autologous fat grafting of the breast





## ABBREVIATIONS

ASPS: American Society of Plastic Surgeons
DCIS: Ductal carcinoma in situ


## KEYWORDS

Mammography; tomosynthesis; lipomodeling; fat grafting; cancer; recurrence; fat necrosis