RESEARCH PAPER

Evaluation of Volumetric, Clinical, and Aesthetic Results of Breast Lipostructuring After Breast-Conserving Surgery and Radiotherapy: An Observational Study

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Abstract

Objective: This study aimed to assess volumetric outcomes indicated by fat graft retention, clinical aspects, and aesthetic results of immediate lipofilling in breast cancer patients undergoing breast-conserving surgery followed by radiotherapy.

Material and Methods: Forty women with early-stage breast cancer underwent breast-conserving surgery with immediate lipofilling at the National Cancer Institute, Cairo, Egypt. All patients received adjuvant radiotherapy. Fat retention was evaluated by magnetic resonance imaging (MRI) at 1st, 9th, and 18th months and by mammography at 1st and 18th months post procedures. Clinical outcomes were recorded, and patient and surgeon satisfaction were assessed on a scale of 1 to 10.

Results: The patients' mean age was 49.3 years, and their mean body mass index was 24.4 kg/m². Most patients (72.5%) had invasive ductal carcinoma. The mean injected fat volume was 183 ml, primarily harvested from the abdomen. Patient and surgeon satisfaction rates were high, with 92.5% rating outcomes as excellent to good. Clinically, edema was present in all cases; infection was present in only 5%, and hematoma in 17.5%. Fat retention rates assessed by mammography and MRI showed a gradual decline over time: from 77% at the 1st month to 56% in the 18th month, versus 90% to 61% over the same period, respectively. The overall complication rate was acceptable, and most adverse events were manageable and non-severe.

Conclusion: Immediate lipofilling after breast-conserving surgery and radiotherapy is feasible, with a high level of satisfaction for both patients and surgeons, manageable complication rates, and substantial fat retention over 18 months.

Keywords: breast cancer, breast-conserving surgery, lipofilling, fat graft retention, volumetric assessment, radiotherapy.

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Introduction

Breast cancer remains the most prevalent malignancy among women globally, with its incidence rising steadily over recent decades.[1] It is a leading cause of cancer-related mortality in women, representing a significant public health concern worldwide. Advances in early detection, systemic therapies, and surgical techniques have markedly improved survival rates and quality of life for breast cancer patients.[2]

The standard of care for early-stage and noninvasive breast cancer has shifted toward breast-conserving surgery (BCS), which aims to excise the tumor while preserving as much healthy breast tissue as possible.[3] Research has established that BCS, followed

by radiotherapy, offers long-term survival outcomes equivalent to mastectomy, while reducing the risk of local recurrence, providing superior cosmetic results, and improving psychosocial well-being.[4]

As the focus of breast cancer management expands beyond survival to encompass quality of life and aesthetic outcomes, reconstructive techniques have become integral to comprehensive breast cancer care. Post-BCS breast reconstruction not only restores breast form and symmetry but also contributes significantly to the psychological recovery and self-image of patients.[5]

The choice of reconstructive techniques is influenced by factors such as tumor size and location, the volume of tissue excised, patient body shape, and individual preferences.[6] Among the array of reconstructive options, autologous fat transfer, commonly referred to as lipofilling, has gained widespread acceptance for its ability to restore breast contour, volume, and symmetry with minimal donor site morbidity.[7]

Lipofilling involves harvesting adipose tissue, typically from the abdomen or thighs, processing it, and reinjecting it into the breast to correct contour defects and asymmetry following tumor excision. This technique is particularly advantageous in patients with small-to-moderate volume deficits and those seeking more natural reconstruction. [7] Immediate lipofilling, performed at the time of BCS, has been associated with improved graft survival, reduced operative morbidity, and enhanced patient satisfaction.[8]

A critical aspect of successful breast reconstruction with lipofilling is the accurate evaluation of fat graft survival and volumetric retention over time. Fat graft resorption is a well-documented phenomenon, with reported retention rates widely varying in the literature, from as low as 30% to as high as 80%, depending on the technique, patient factors, and assessment methods.[9,10] Recent evidence highlights the dynamic nature of fat graft retention, with the greatest volume loss occurring within the first six to twelve months post-procedure, followed by stabilization. [10]

Advanced imaging modalities, such as mammography and magnetic resonance imaging (MRI), have become indispensable tools for volumetric assessment of reconstructed breasts. They facilitate quantification of fat retention, detect complications, and distinguish benign postprocedural changes from potential malignancies. [11, 12]

Despite its recognition, lipofilling has challenges. Complications and variable fat graft retention rates have been reported, and concerns persist regarding the long-term oncological safety in the context of breast cancer.[13] The unpredictability of fat graft survival underscores the need for objective, longitudinal volumetric evaluation to optimize surgical planning, patient counseling, and outcome assessment.

Integrating objective volumetric assessment into routine clinical practice is essential for the ongoing refinement of breast lipo-structuring techniques by enabling surgeons to tailor their approach to individual patients, anticipating the need for secondary procedures, and providing realistic expectations regarding aesthetic outcomes. Therefore, the present study was designed to evaluate the volumetric outcomes by assessing fat resorption rates, clinical aspects, and aesthetic results in breast cancer patients undergoing immediate lipofilling following BCS and radiotherapy.

Methods

Study settings and ethical considerations

The current prospective trial was designed to investigate fat resorption rate, evaluate clinical aspects, and assess aesthetic outcomes in breast cancer patients who underwent BCS with immediate lipofilling and radiotherapy. The study was conducted at the National Cancer Institute in Cairo, Egypt, and was granted the institutional review board (IRB) approval [No. 201516041.3] on 10 July 2016.

Before enrolling in the study, each patient was given an information sheet with a detailed explanation of the aim, study procedures, benefits, possible risks, and potential consequences of autologous fat grafting. They were also advised of further investigations that might be needed in case of suspicious findings. Informed consent was obtained to ensure patients' autonomy. Also, patients' data were kept anonymous for privacy and confidentiality.

Study participants

Patients were selected among female breast cancer patients from the National Cancer Institute when their ages ranged from 40 to 60 years, had malignant breast lesions, ductal carcinoma in situ (DCIS), T1 breast lesions, T2–N0, or N1-M0. They were also included in the study if they had luminal A or B biological types (hormone-positive), underwent bilateral sonomammography and tumor biopsy before surgery, had adequate fat reserve, and were motivated and committed to follow-up.

Patients were excluded if they had tumors suspicious of multicentricity or multifocality, if they were positive for metastasis, had locally advanced disease, or suffered from systemic diseases and/or comorbidities (systemic lupus, autoimmune diseases, uncontrolled diabetes, chronic renal and hepatic diseases, etc.).

A detailed, informed evaluation of patients was done to assess their eligibility and minimize the risk for adverse outcomes. Data on age, body mass index (BMI), clinical, pathological, and surgical histories, treatments received, and volume of fat transferred were collected and recorded on the data collection sheet.

Study procedures

Preoperative preparations

Tissue biopsy was performed for all patients to evaluate tumor type, subtype, and prognosis. Preoperative photographs were taken in all cases. For volumetric assessment, mammography and breast ultrasonography were performed preoperatively and at 1 month (baseline) and 18 months postoperatively, whereas MRI was performed at baseline, 9 months, and 18 months.

Identification of the donor site

Donor site selection was individualized, guided by patient anatomy and the potential need for subsequent corrective procedures. The abdomen was prioritized as the primary site due to its abundant adipose tissue and the ability to maintain the patient's position during the procedure. The trochanteric region was considered the secondary site. Before initiating the harvest, the donor sites, breast contour, and lesion site were meticulously marked on the skin, and pre-operative photographs were taken with the patient standing.

Surgical technique for BCS

Surgical intervention adhered to a standardized protocol, prioritizing complete tumor resection via cosmetically sensitive incisions tailored to the tumor's precise location and orientation. After confirming pathologically negative margins, as guided by international consensus (no ink on tumor), multiple metal clips were placed in the tumor cavity in patients who will need a radiotherapy boost. After that, the cavity created inside the breast after tumor resection was meticulously closed edge-to-edge with resorbable material. This traction of the defect's center leaves significant deformities distal to the tumor bed, considering the overall shape and projection of the breast, with a specific attention to skin changes indicative of Cooper's ligament involvement.

Lipofilling technique

1. Preparation and solution injection

Tumescent solution, typically Klein's solution, was prepared and subsequently infiltrated into the designated donor site. The solution was injected through a small-bore 4 mm blunt cannula, and a hand- held pump was used to ensure continuous infusion. Fat harvesting started at least 15 minutes after the infusion.

2. Fat harvesting

In this study, modified Coleman's approaches were used. The modified approach involved replacing the 10 cc Luer-Lock syringe with 60 cc Toomy syringes and a vacuum device with a specialized sterile container connected to a 3 & 4-mm cannula with 2 orifices in the same axis. During liposuction, a conservative approach was employed, meticulously preserving the superficial fat layer. This strategy minimized the likelihood of contour irregularities and skin necrosis.

3. Fat processing

Decantation was used first in some patients by leaving the material obtained to settle for 15 minutes. Fat was then transferred into multiple 3-5 cc Luer-Lock syringes before putting it in the centrifuge. Then, centrifugation at 3000 rpm for one minute was used to separate the fat into 3 distinct layers. In the rest of the patients, centrifugation was used directly without decantation to minimize processing time.

4. Fat transfer (injection)

To achieve a three-dimensional contour and minimize the risk of fat necrosis, fat grafting was performed using a multi-layered approach, injecting fat from the deep to the superficial tissue planes. Bicompartmental breast lipostructuring was used, then manual reshaping and careful assessment were done for the final aesthetic outcome.

Following tumor resection, targeted fat grafting was meticulously performed using a 1.6 mm single-orifice cannula. This technique involved multiplanar, retrograde injections into the mammary gland surrounding the resection site along linear paths, avoiding cavity formation. To restore breast projection compromised by the resection, subcutaneous fat grafting was then performed adjacent to the skin incision, with additional intra-glandular injections as needed.

Finally, with the patient in a semi-sitting position, Cooper's ligament irregularities were addressed via a V-tip (Rigotomy) cannula. This step aims to release skin retractions and refine the breast contour, optimizing

aesthetic outcomes. Notably, none of the patients required concurrent contralateral breast symmetry procedures, such as augmentation or reduction.

Post-procedural approach

Based on their immunohistochemical profile, tumor criteria, and nodal status, patients received chemotherapy, targeted therapy, and hormonal treatment according to a multidisciplinary team decision. All patients received adjuvant radiotherapy as an integral part of the BCS management protocol.

To minimize the extent and duration of edema in the donor and recipient sites, patients were instructed to use abdominal binders/corsets, early and frequently ambulate, and to avoid any compression on the reconstructed breast (either clothes or position), frequent use of fomentation, applying gentle massage, adherence to medical treatment, and seeking medical advice on any sign of complications.

Follow-up schedule included clinical examination on day 7, week 4, and every 3 months for the first 2 years, as well as radiological follow-up as previously mentioned, in addition to metastatic work-up guided by clinical situation.

Study outcomes and follow-up measures

Clinical and aesthetic evaluation

Both patients' and the surgeon's satisfaction were assessed regarding skin quality, volume, symmetry, contour, scarring, and texture. Scores ranged from 1-10, where 9-10 was considered excellent (the reconstructed breast exhibits excellent form and symmetry, resulting in high patient satisfaction), 5-8 as good (breast shape and symmetry were imperfect but within the normal range, patient is satisfied), and 1-4 as poor (the breast is not acceptable in shape or symmetry, patient is slightly satisfied to dissatisfied).[14] Also, some possible complications of the donor and recipient sites, including pain, paresthesia, bruising, swelling, hematoma, and infection, were clinically evaluated and recorded.

Volumetric (radiological) assessment

Two main imaging modalities, mammogram and ultrasonography, as well as MRI, were used to estimate breast, retained fat, and injected fat volumes to calculate the fat retention rate. Pristina GE mammogram device (GE Healthcare, USA), with a 24*29 cm digital detector and a pixel size of 100µm, was utilized to calculate breast volume according to Kalbhen et al.[15], who assumed that, in craniocaudal mammography, the compressed breast is modeled as a half-elliptical cylinder to facilitate analysis. They used the formula: V_{MMG} = (π/4) × breast height (cm) × breast width (cm) × compression thickness (cm) in the craniocaudal direction, Figure 1

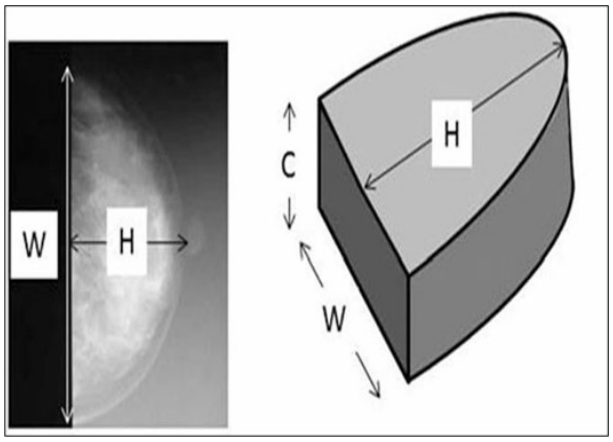

Figure 1: Measuring breast volume with the mammogram, employing three key measurements: breast height (H), breast width (W), and compression thickness (C), all expressed in centimeters.[16]

To establish the success of the lipofilling approach, graft survival, indicated by the fat retention percentage, was calculated by dividing the final augmented fat volume (ml) (augmented breast volume minus the pre-injection breast volume) at the assigned intervals (T1, T9, T18) by the initial injected volume (ml).[17]

Statistical analysis

Data was analyzed utilizing the statistical package for the social sciences (SPSS) (version 21 for Windows). Data for the current study included patients' baseline characteristics (age, BMI, tumor criteria, volume of transferred fat), patients' and surgeons' satisfaction, and fat retention rates evaluated by mammography and MRI. Mean and standard deviation (SD), as well as frequency and percentage, were used to express data whenever appropriate. The statistical significance level was set at P- value < 0.05.

Results

The current study included 40 female cases, all of which were assessed for clinical and aesthetic outcomes, as well as volumetric evaluation.

Demographic and clinical characteristics

The study population comprised 40 female participants with a mean age of 49.3 ± 5.5 years and a mean BMI of 28.9 ± 2.2 kg/m^2. Table 1 presents patients' demographics, tumor criteria, treatment received, the

donor site used for fat harvesting, and the average fat injection volume.

Clinical and aesthetic outcomes

As presented in Table 2, clinically evident complications included edema in all participants, infection in 5% (n=2), and hematoma in 17.5% (n=7). The overall patient satisfaction was high (52.5% (n=21) reporting excellent satisfaction versus 7.5% (n=3) poor). Surgeon satisfaction mirrored this, with a slight difference (40% excellent versus 7.5% poor).

Table 1. Baseline and clinical characteristics of the studied group (n=40).

Variables	Statistics
	Mean± SD
Age (years)	49.3±5.5
Body mass index (kg/m^2)	28.9 ±2.2
Fat injection volume (ml)	183 ±18.9
	N (%)
Tumor size	
▪ **T1**	16 (40%)
▪ **T2**	24 (60%)
Lymph node status	
▪ **N0**	23 (57.5%)
▪ **N1**	17 (42.5%)
Side/ Laterality	
▪ **Right**	23 (57.5%)
▪ **Left**	17 (42.5%)
Quadrant	
▪ **Upper inner**	10 (25%)
▪ **Upper outer**	22 (55%)
▪ **Lower outer**	8 (20%)
Biological type	
▪ **Luminal A**	27 (67.5%)
▪ **Luminal B**	13 (32.5%)
Histological type	
▪ **Ductal carcinoma in situ**	8 (20%)
▪ **Invasive lobular carcinoma**	3 (7.5%)
▪ **Invasive ductal carcinoma**	29 (72.5%)
Histological grade	
▪ **1**	8 (20%)
▪ **2**	32 (80%)
Chemotherapy	
▪ **Adjuvant**	20 (50%)
▪ **Neoadjuvant**	4 (10%)
▪ **No**	16 (40%)
Targeted Therapy	8 (20%)
Hormonal therapy	40 (100%)
Donor site	
▪ **Abdominal**	31 (77.5%)
▪ **Trochanteric**	9 (22.5%)

Data were expressed as mean and standard deviation (SD) and numbers and % (n%).

Table 2. Clinical and aesthetic evaluation in the studied group (n=40).

Variables	N (%)
Complications	
Edema	40 (100%)
Infection	2 (5%)
Hematoma	7 (17.5%)
Patients' satisfaction	
Poor	3 (7.5%)
Good	16 (40%)
Excellent	21 (52.5%)
Surgeon's satisfaction	
Poor	3 (7.5%)
Good	21 (52.5%)
Excellent	16 (40%)

Data were expressed as numbers and % (n%).

Volumetric assessment and assessment of fat retention

As presented in Table 3 and Figure 2, fat retention measured by the mammogram showed a 26.9% absolute reduction from baseline to the 18th month (76.9 ± 4.9 % versus 56.2 ± 5.4%), with a statistically significant difference ($p \leq 0.001$), while MRI measures revealed higher baseline retention compared to mammography, also with a statistically significant difference ($p \leq 0.001$).

Table 3. Volumetric assessment of fat retention rate in the studied group (n=40).

Variables	Mean± SD (in %)	P Value
Retention rate measured by mammogram		

1st month postintervention	76.9 ± 4.9	≤ 0.001*
18th month postintervention	56.2 ± 5.4	
Mean difference (18th -1st month)	−20.6±5.9	
Overall change % (18th - 1st month/ 1st month)	-26.9	
Retention rate measured by MRI		
1st month postintervention	89.9 ± 3.5	≤ 0.001*
9th month postintervention	73.9 ± 12.7	
18th month postintervention	60.9 ± 5.4	
Mean difference (18th -1st month)	−28.8±3.3%	
Overall change % (9th -1st month/ 1st month)	-17.9	
Overall change % (18th -1st month/ 1st month)	-32.1	

Data were expressed as mean and standard deviation (SD) and numbers and % (n%), *: significant at P ≤ 0.05.

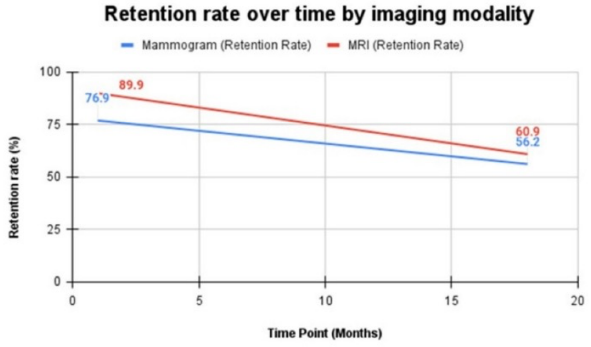

Figure 2: Mean retention rate as measured by MRI and Mammogram.

Discussion

Breast cancer incidence in women continues to rise, solidifying its position as the most prevalent malignancy and a leading cause of cancer-related deaths worldwide.[1] post-BCS reconstruction using lipofilling can improve contour, add volume, and achieve symmetry, restoring the aesthetics of the breast,[7] though it has downsides.[13]

The current study was conducted to explore the feasibility and safety of autologous fat transfer, evaluate clinical and aesthetic outcomes, and assess fat retention rates in breast cancer patients who underwent BCS with immediate lipofilling followed by radiotherapy.

Patients included in this study had mainly invasive ductal carcinoma (72.5%; n=29). The findings of Rizk et al.[10] stated invasive ductal carcinoma as the only cancer type (100%; n=25) in their cases. Moreover, invasive ductal carcinoma was reported to be the most common breast cancer type according to Biazus et al.[9] and De Biasio et al.[18] (99.2%, 97.6% of their cases, respectively).

For the donor site, 31/40 patients in this study had their harvested fat from the abdominal region, and the rest had it from the trochanteric region. According to Hamza et al.[19], abdominal fat is the most commonly harvested site because it contains the highest fat deposits. Also, it does not require changing the patient's position during the operation. The trochanteric region, the inside of the thighs, and the knees are, on the other hand, the second sites to consider.

The fat volume injected in the current study (183±18.9 ml) was more than the excised breast tissue, with a deficit overcorrection of around 20-30% to account for the anticipated fat resorption rate within the first 3 months of the procedure. Similarly, the study by Rizk et al.[10] accounted for fat absorption by the body and injected more fat than the excised breast tissue (1.4 times the volume of excised tissue). Also, Biazus et al.[9] reported the median fat graft volume to be 2.7 times more than the resected volume.

Regarding aesthetic evaluation, patient satisfaction was high, with around 92.5% (n=37/40) reporting excellent to good satisfaction. Surgeon satisfaction mirrored this with the same percentage. These findings indicate that both patients and the surgeon were generally satisfied with the outcomes. However, 7.5% of patients reported poor satisfaction, which may be attributed to unrealistic expectations, suboptimal aesthetic outcomes, or complications experienced during the follow-up period.

These results were consistent with previous studies, indicating high levels of satisfaction among patients undergoing lipofilling post-BCS. For instance, a study by Rizk et al.[10] demonstrated similar satisfaction rates from both the surgeon's and patients' viewpoints, attributing that to improved breast symmetry, enhanced aesthetic appearance, and overall psychological well-being.

Supporting this, Ahmed et al.[13] reported that 96.3% of patients expressed satisfaction following

immediate lipofilling. Similarly, Biazus et al.[9] found that most cases received very good aesthetic scores. In a systematic review by Largo et al.,[20] seven out of twelve studies focused on volume restoration via fat grafting reported excellent results. Additionally, Moltó García et al.[8] highlighted significant improvements in breast symmetry noted by both surgeons and patients, with over 90% of respondents rating their satisfaction at the highest level. Unlike our findings, De Biasio et al.[18] found that 75% of women in their study considered the aesthetic outcomes excellent at the 18-month mark, while the remaining 25% rated the results as good, with no participants indicating a poor outcome.

Clinical evaluation in the present study indicated that the incidence of edema was 100% of all cases, signifying an inevitable postsurgical sequela. Other clinically observed complications included infection in two cases (5%) and hematoma in seven cases (17.5%). In the study by Rizk et al.,[10] 8% of cases (n=2) had infection, and only one case had postoperative hematoma. Also, our study's infection occurrence rate was lower than the findings of Gil-Londoño et al.,[21] who stated an incidence of 10.2-30%. This indicates that using clean sterile procedures would decrease the incidence of such complications. Also, excluding participants with other infections- augmenting factors such as diabetes would result in decreased rates, compared to other studies.

The hematoma rate of 17.5% highlights the need for meticulous surgical technique and hemostasis. Klein's solution was injected into the donor site (50 mL of 1% lidocaine solution) to obtain hemostasis and reduce postoperative pain. Though our study's rate was higher than the ranges reported by Neal et al.,[22] who stated a range of 2-10%, most of the hematomas observed were of small volume in the form of skin ecchymosis.

Volumetric assessment showed a progressive decline in fat retention rates across multiple post-intervention time points, as measured by mammography and MRI. Mammographic assessment demonstrated a relative reduction of nearly 27% by the eighteenth month. MRI measurements, which initially indicated higher retention rates (around 90% at baseline), similarly showed a decline of 32% at the same time point.

These results were higher than those mentioned in a recent prospective three-year MRI-based study in breast fat grafting. That study reported stabilized fat graft retention of 46% at approximately 8 months post-procedure, with retention heavily influenced by postoperative weight changes.[23] Similarly, a randomized trial by Chen et al.,[24] aiming to evaluate the impact of different fat processing techniques on volume retention rates, found that at three months, retention rates ranged from 50% to 70%, depending on the method used.

The retention rates observed in these studies, along with the present study, highlight that fat graft volume goes through a gradual resorption phase during the first 1-1.5 years post-transplantation, followed by a plateau stage. Retention rates vary but often fall within the 50–70% range at one year, depending on patient factors and surgical technique.[12] The current study's retention rates at eighteen months (56% by mammography and 61% by MRI) are therefore within the expected range reported in the literature, supporting the clinical relevance of these findings.

Notably, the intermediate MRI measurement at nine months (74% retention) in this study reflects the dynamic nature of fat graft survival, consistent with longitudinal imaging studies that show a gradual decline rather than abrupt volume loss.[23] This sequential pattern must be taken into consideration when counseling patients concerning expected outcomes and potential need for secondary procedures.

Regarding the discrepancy between mammographic and MRI retention rates observed in this study, MRI offers superior soft tissue contrast and three-dimensional volumetric assessment capabilities, enabling more accurate quantification of fat graft volume and viability.[12] Mammography, while widely accessible and routinely used in breast cancer follow-up, provides two-dimensional images that can underestimate fat volume due to tissue overlap and limited contrast resolution.[24] This explains why, consistent with our results, Wang et al.[25] found that MRI showed 10–15% higher retention compared to 3-dimensional imaging in paired analyses.

Recent comparative studies emphasize that MRI is the preferred modality for precise volumetric analysis in fat grafting, particularly in the breast, where complex tissue heterogeneity and post-surgical changes can confound mammographic interpretation.[26] Moreover, advanced imaging techniques such as three-dimensional surface scanning and ultrasound have been explored but currently lack the accuracy and reproducibility of MRI for volumetric fat assessment.[24] Despite its limitations in terms of cost and availability, MRI maintains its position as the definitive diagnostic tool, providing unparalleled soft tissue contrast without the risks associated with ionizing radiation.[27]

In contrast, Itsukage et al.[16] previously concluded that calculating fat retention rate using mammography from breast volume measurements required only a simple formula to provide satisfactorily accurate results. They suggested that mammography could be used as an alternative to MRI.

The literature highlights that the choice of imaging modality can impact the interpretation of graft survival and thus affect clinical decision-making. Therefore, the present study employed a multimodal imaging approach that combined the strengths of MRI and the practicality of mammography to offer a more comprehensive evaluation, as suggested by Sampathkumar et al.[12] Fat retention and resorption rates are largely influenced by a combination of factors: surgical technique, biological environment, and patient characteristics. Using modified Coleman's approaches and Rigotomies decreased the incidence of fat necrosis, which helped fat graft survival. Key procedural variables, including the methods of fat harvesting, fat processing (e.g., centrifugation, filtration), injection technique, and recipient site preparation, were also perceived as critical determinants of graft survival.[24] In a meta-analysis conducted by Hu and Xu,[28] following different fat processing procedures (centrifugation vs. sedimentation) accounted for a 13% difference in fat retention.

On the other hand, some biological factors could also be linked and have an impact on graft survival and retention rates. For instance, recipient site vascularity, local tissue hypoxia, and inflammatory responses.[29] In cases of radiotherapy, the irradiated breast tissue creates an unfavorable recipient site, which could obstruct adequate vascularity and the supply of nutrients to the graft. Also, fibrosis resulting from previous operations or irradiation largely affects the integrity of the tissues in that site.[30]

Patient-related variables such as BMI, hormonal fluctuations, metabolic status, and postoperative weight variations have also been demonstrated to impact breast volume and fat retention.[27] Changes in BMI pre- and post-surgery strongly correlated with breast volume. Ørholt et al.[23] showed that patients with postoperative weight gain had significantly higher fat graft retention compared to those who lost weight, highlighting the importance of systemic factors beyond surgical control. A BMI decrease of 9% may correspond to a 20% reduction in breast volume, while weight gain has the opposite effect.[31]

Additionally, breathing patterns and posture during imaging, along with anatomical variations in breast shape and contour, can introduce inconsistencies in breast volume measurement, given the differences in patient positioning, especially between MRI (prone) and mammography (upright).[32]

The strengths of this study include its prospective design, objective volumetric evaluation, and detailed methodology. However, limitations included the relatively small sample size (n=40), the lack of a control group, and the limited follow-up duration of 18 months. Though this follow-up period is similar to other studies, Sampathkumar et al.[12] highlighted that a minimum of 5 years of follow-up is needed for all stages of fat graft to occur before performing the outcome assessment. Although breast volume assessment ideally quantifies the aesthetic impact of lipofilling, it was not feasible to assess breast volume at all time points due to the variability and unpredictability of factors influencing breast volume. The current study did not control or measure postoperative weight changes or metabolic parameters, which may partly explain variability in retention rates.

Future research should focus on maximizing fat retention by improving surgical procedures and investigating adjuvant treatments such as stromal vascular fraction enrichment and recipient site pre-expansion. Furthermore, larger, multicenter clinical studies with longer follow-up durations are required to develop more generalizable data and rigorously examine long-term oncological safety.

In conclusion, based on the study findings, immediate lipofilling following BCS and radiotherapy is a safe and effective reconstructive option that achieves favorable aesthetic results, with manageable complication rates. Fat retention rates, although declining over time, remain better than those reported in some other studies, highlighting the benefits of immediate reconstruction.

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Conflict of interests

The authors declare no potential conflicts of interest.

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