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ORIGINAL PAPER

Total breast reconstruction with fat graft after serial expander deflation: a case series

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Abstract

Fat graft popularity has increased over the last few decades, finding a widespread pattern of application in oncological reconstruction, wound therapy and cosmetic surgery. Recently, the fat graft has been used for breast volume replacement after skin modelling by conventional tissue expanders positioned during mastectomy or after forced removal of prostheses due to complications. Our purpose was to assess fat grafting feasibility and safety, indicating its low rate of complications. We retrospectively analysed 7 patients treated with autologous fat grafts after oncological surgery for breast cancer. Patients not eligible for implant reconstruction and patients who refused implants were included. We analysed age, BMI (Body Mass Index), expansion rate and grafting data (session numbers, injected volume in each session and complication rates). Clinical examinations were performed every 6 months for 1 year after complete reconstruction to evaluate adipose tissue reabsorption and, eventually, further required fat grafting sessions. The aesthetic outcomes were excellent in all of the patients in our series. According to patient surveys, the satisfaction rate was very high. The filled expanders' final volumes varied from 270 to 630 mL (average: 420 mL). The number of fat grafting sessions ranged between 2 and 3 (average 2.43), and the injected grafting volume during each session varied from 35 to 300 ml (average 175.43 ml). Expander deflation during each surgery session varied from 50 to 270 ml (average 100.63). No complications were reported. Our technique is useful and innovative and leads to good aesthetic results with shorter hospital recovery and low complications rates, compared to major reconstructive surgery. Moreover, the oncological safety appears to be uncompromised. Therapeutic, IV.

Keywords Fat graft · Reconstructive surgery · Prosthetic implants · Autologous tissue

Introduction

Over the years, the variety of breast reconstruction techniques has increased with an improvement in efficacy. Autologous tissue and prosthetic implants can both be used in breast reconstruction surgery, with or without previous tissue expander placement. Autologous reconstruction can use free flaps, pedicled transverse rectus abdominis myocutaneous (TRAM) flaps, deep inferior epigastric perforator flaps (DIEP) and latissimus dorsi flaps (LD) [1]. The most important advantage of prosthetic tissue reconstruction is the shorter operative time [2]. Autologous tissue reconstruction, conversely, can achieve a superior aesthetic result and improve outcomes in specific subpopulations of patients (e.g., pre-operative history of external beam radiation therapy and chest wall involvement), but it has a certain degree of donor site morbidity [3]. Autologous flaps have the highest overall complications rates [4], compared to the other existing reconstructive options. Implant-based reconstruction complications include implant exposure or extrusion, rupture, deformation or distortion, rippling and migration. Late complications can also occur: capsular contracture, for instance, can lead to implant prominence, sensitivity distortion and pain and can require the implant to be replaced or removed.

As per Manconi et al. [5], our study presents 10 mastectomies for breast cancer in which breast volume replacement was obtained by serial lipofilling sessions after progressive skin expansion.

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Material and methods

We retrospectively analysed seven patients treated with autologous fat grafting after oncological surgery for breast cancer from December 2010 to December 2017 in the Plastic Surgery Department of Turin University Hospital. According to the AJCC 2009 classification, the cancer staging was I in 3 of 7 patients, IIA in 2 of 7 patients, IIIA in 1 of 7 patients, and IIIC in 1 of 7 patients. Patients not eligible for implant reconstruction and patients who refused implant placement were included. The variables considered were age, BMI, expansion rate, grafting data (session numbers, injected volume in each session and complications rate; Table 1).

The breast expander was placed under the pectoralis major muscle during the same surgery session as mastectomy. After an average of 3 weeks, the expander was filled with saline solution until the final desired volume was achieved. Afterwards, progressive expander emptying and simultaneous fat graft filling were performed. Finally, the tissue expander was removed, and if necessary, breast symmetry surgery was performed. The purposes of the tissue expander were obtaining a sufficient amount of stretched skin to achieve a natural ptotic look and amplifying the recipient site surface.

The donor site (e.g., abdomen, thigh) was infiltrated with diluted epinephrine in saline solution. Liposuction was performed using 3- to 4-mm blunt cannulas. Lipoaspirate remained in the saline solution until adipose tissue separated from the blood and oil components. The oil and serum were then removed, and the purified fat was transferred to a strainer and further concentrated. Finally, it was transferred to 5-mL Luer-Lock syringes and, with the surgeon using a blunt cannula, was placed into subcutaneous layer, forming single lines or a small fat graft mass to avoid liponecrosis [6]. The volume injected during each lipofilling surgery session ranges was 35–300 ml.

All of the patients required 1–3 days of hospitalisation and antibiotic therapy (β-lactam antibiotic and clavulanic acid or fluoroquinolones for 7 days). Adequate volume was attained in 3 months or more because of graft reabsorption (between 10% and 50% of the injected volume). Fat grafting could be repeated after 6 months or more.

The deflation expander and fat grafting session numbers depended on anatomy of the patient, breast volume, fat tissue availability and fat graft amount for each session. Generally, restored breast volume was achieved in 2 or 3 fat grafting sessions (Figs. 1 and 2).

After complete tissue expander deflation, the expander could be removed during the final surgical session simultaneously with the last fat graft and contralateral breast symmetry surgery, if necessary. All of the surgical operations were performed by the first author.

Clinical examination was performed every 6 months for 1 year after complete reconstruction to evaluate adipose tissue reabsorption and, eventually, further required fat grafting sessions.

Results

From 2010 to 2017, 7 patients (Table 1) were enrolled. The average age was 46.14 years old (range 30–70), the average BMI was 24.7 (range 21–27), and the average follow up was more than 1 year (range 3 months to more than 3 years).

Two patients with BRCA1 mutations underwent prophylactic bilateral nipple sparing mastectomy with immediate skin expander implants, and five patients underwent skin-sparing mastectomy with immediate skin expander implants. Siltex Mentor Moderate Profile or Low Profile expanders and Allergan Natrelle® 133 shaped tissue expanders were used, ranging in volume from 350 to 650 mL. The filled expanders' final volumes ranged between 270 and 630 mL (average: 420 mL). The number of fat grafting sessions varied between 2 and 3 (average 2.43), and the grafting volume for each session ranged from 35 to 300 ml (average 175.43 ml). The mean expander deflation for each surgery session varied from 50 to 270 ml. During the follow-up, no complications occurred. Satisfactory aesthetic results were observed at 6 months after the last session (Fig. 2). Patients were clinically evaluated at 6 months and at 1 year after the last fat graft, and no additional lipofilling was required. The patients' satisfaction was reported to be good.

Discussion

Over the last few years, the development of breast-conserving surgery and oncoplastic techniques has been observed, with improvement in the reconstruction techniques. Breast reconstruction options include tissue expander placement followed by final implant placement, autologous tissue transfer, or a combination of both methods; immediate or delayed reconstruction can be performed with both implant expanders and fat grafting.

The aim of reconstructive surgery should be to achieve an oncologically safe and long-term aesthetically favourable outcome, with reasonable costs. The reconstructed breast should look natural and symmetrical and be soft and sensitive [7].

Reconstructive technique choice depends on habitus, patient wishes and preference, risk factors (smoking, diabetes mellitus, obesity, previous surgeries, radiation, history of thrombosis, cardiovascular disease, etc.), planned post-mastectomy radiotherapy (PMRT) and surgeon skills.

Table 1 Data collected about fat graft series. *MD* missing data, *FU* follow up, *NED* no evidence of disease, *NSM* nipple sparing mastectomy, *SSM* skin-sparing mastectomy

Patient	Age, year	BMI	Surgery	Tissue expander model and initial filling	Expansion volume, mL	Implant model and removal cause	Saline aspirated for each session, mL	Fat grafting session	Injected fat for each session (mL)	Implantation time, years	Complications	Staging	Date of last FU	State of disease
1	35	27,3	BRCA1, prophylactic bilateral NSM	Mentor CPX4 450 cc, with 120 cc, bilateral implant	Left 630 right 490		Left 170—perforated and deflated SE-removal Right 70–80 removal	3	Left 145–265–245 Right 145– 85 -225	1,5	–	1	5 Apr. 2018	NED
2	30	21,5	BRCA1, prophylactic bilateral NSM	Mentor CPX 4350 cc, with 130 cc, bilateral implant	Left 280 Right 280		Left 50—no aspiration Right 50—no aspiration	2	Left 100–140 Right 85–260	Currently implanted	–	2A	22 Jan. 2018	NED
3	46	25	NSM	Mentor CPX 8100 450 cc, with 100 cc	400		250—removal	2	300–240	0,7	–	1	19 Apr. 2018	NED
4	48	26,4	SSM	Mentor CPX 8200 350 cc, with 120 cc	270		270—removal	2	200–235	1	–	2A	25 Jan. 2018	NED
5	46	27	SSM	Allergan SX 650 cc with 100 cc	470		60–60–120	3	250–200–100	4,3	–	3c	28 Feb. 2017	NED
6	70	25,4	Bilateral SSM	Mentor CPX4 450 with 120 (bilaterally) implant	Left 450 Right 450		Left 60–60 Right 60–60	2	Left 95–35 Right 190–115	4	–	Left 1 Right: MD	3 May 2018	NED
7	48	22.3	SSM	Mentor CPX4 450 with 120	450		60–130-removal	3	130–165–200	2,2	–	3A	12 Feb. 2018	NED

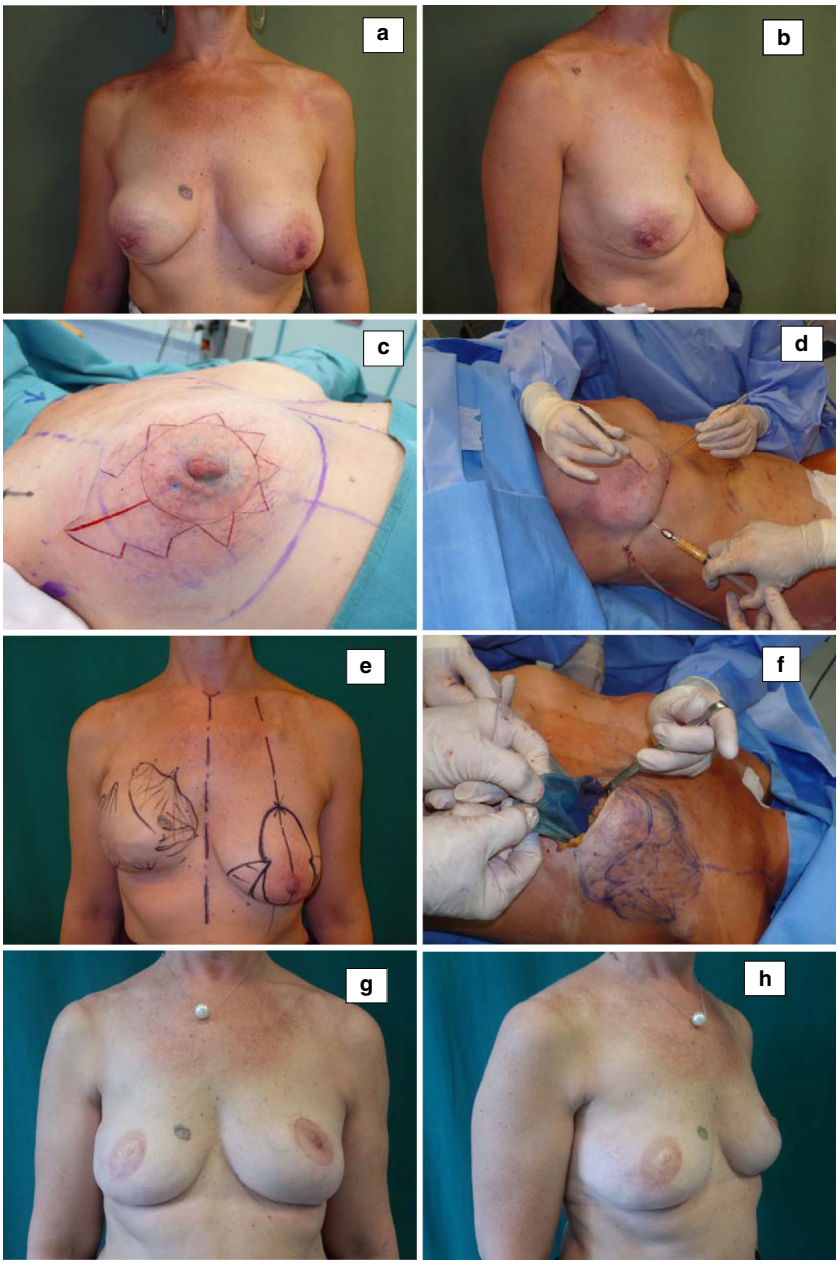

Fig. 1 Pre-operatory pictures (**a**, **b**). Scar comet incision mastectomy and tissue expander implant (**c**), lipofilling session (**d**), contralateral breast surgical planning (**e**), tissue expander removal (**f**), aesthetical result at 6 months (**g**, **h**)

Some particular types of incisions used for mastectomy can lead to significant problems for the cosmetic results of reconstruction [8].

Furthermore, existing reconstructive options are not without morbidity. Sullivan et al. [9] reported that complications were identified in 155 breast reconstruction (46.4%) of 334 cases using tissue expanders, implants, autologous tissue (pedicle flap, TRAM flap, latissimus dorsi) or free flap (Diep/Tram flap) reconstruction. Like Alderman [5], the Sullivan et al. series did not find differences in surgical complication rates between tissue expanders/implants and autologous tissue reconstruction or between specific types of autologous tissue reconstruction. However, the authors reported a higher complication rate following immediate tissue expander/implant reconstruction.

Autologous flap reconstruction complications include total (0.5–5%) [10–12] or partial flap necrosis, vessel thrombosis, infection, delayed wound healing, haematoma, seroma and hernia/abdominal wall laxity (after tram flap reconstruction).

Autologous reconstruction patients had the highest rates of overall complications (12.5% vs 5.4%), wound infection (5.5% vs 3.5%), flap/prosthesis failure (3.1% vs 0.9%) and re-operation (9.6% vs 6.8%). Major surgery and prolonged hospitalisation length (3–5 days typically) have been correlated with some complications, such as deep vein thrombosis, pulmonary embolism, pneumonia and blood transfusion necessity [13].

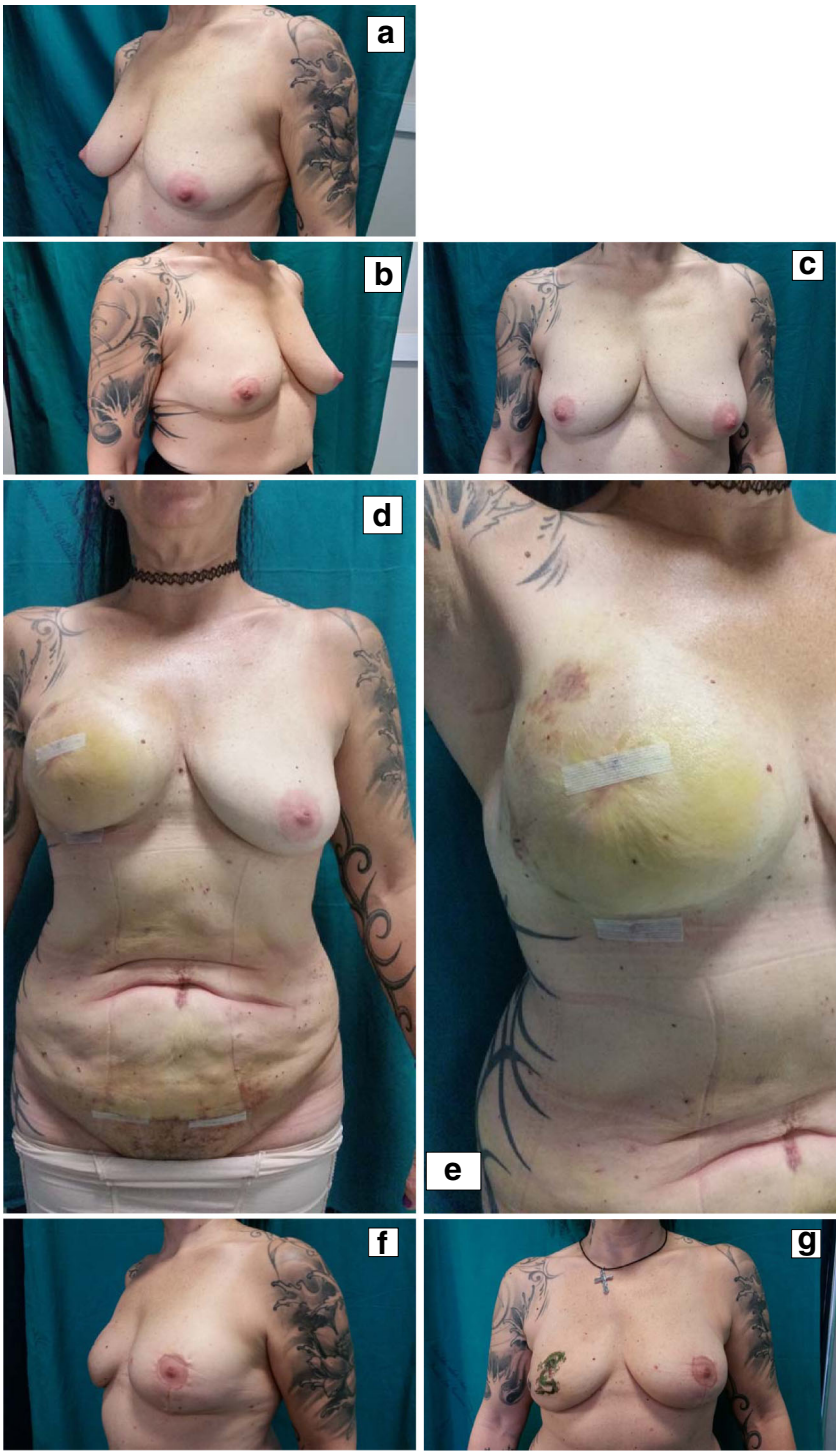

Fig. 2 Pre-operative pictures (**a**–**c**). Before removing tissue expander (**d**, **e**). Final aesthetic result at 12 months (**f**, **g**)

Additionally, implant-based reconstruction can lead to complications such as implant exposure/extrusion, rupture, deformation/ distortion, rippling, migration, and edge visibility. Common complications of tissue expander/implant breast reconstruction include capsular contracture (Baker grade II, III, or IV; 14–41%) [14, 15] deflation (9%), infection (1–24%) [16, 17] and dislocation of the implant.

Allergan's 10-year cumulative risk study found that 24.6% of patients who underwent implant-based reconstruction developed capsular contracture and needed implant removal and/or replacement [18].

Autologous fat transplantation, also known as fat grafting or lipofilling, is an increasingly popular technique used in reconstructive surgery. In 1895, Czerny performed the first documented breast augmentation by transplanting a lipoma

from the lumbar region into a breast defect [19]. Subsequently, other authors have transplanted fat tissue into deep defects after head oncological surgery or trauma. Fat grafts are used in the management of Parry-Romberg syndrome, a soft tissue atrophy in which autologous fat grafting can provide a less invasive alternative compared to the traditional microsurgical free flap coverage, with better aesthetic results [20].

In 1987, Bircoll described liposuction and autologous transplantation of the harvested fat in breast reconstruction surgery [21]. In 1990, Coleman improved the technique, harvesting and processing of fat grafts, obtaining a greater vital adipocyte number and less fat necrosis [22].

In 1987, the American Society of Plastic and Reconstructive Surgeons (ASPRS) declared: "The committee is unanimous in deploring the use of autologous fat injection in breast augmentation, much of the injected fat will not survive, and the known physiological response to necrosis of this tissue is scarring and calcification. As a result, the detection of early breast carcinoma through mammography will become difficult, and the presence of disease might go undiscovered" [23].

Subsequent studies showed that fat necrosis and microcalcifications are potential consequences of any breast invasive approach, including biopsy, reduction, augmentation and reconstruction; given the above, the radiographic follow-up of breasts treated with fat grafting is feasible and safe [24].

Finally, a multicentre study performed by Petit involved 646 lipofilling procedures and concluded that lipofilling after breast cancer treatment does not affect radiologic follow-up and has a low complication rate. Nevertheless, a higher locoregional recurrence rate was reported in lipofilling performed during the first 3 years after breast-conserving surgery.

In light of the low complication rates and good aesthetic results, we propose seriated fat graft sessions in patients who undergo mastectomy and breast expander placement for breast cancer; our surgical technique proved to be a safe and reliable procedure with long-lasting natural aesthetic results, a very low rate of complications and minimal scars. Despite the large number of grafting/deflation sessions, the technique reduced hospitalisation length could be performed under monitored anaesthesia care and required only 1–2 days of hospitalisation.

Conclusions

We believe that fat graft for total breast reconstruction could be a first option in selected cases, including those in which contraindications exist for autologous reconstruction surgery with flaps due to poor general conditions or contraindications to prosthetic implants. Before surgery, it is important to evaluate the amount of fat tissue available and to select a small to medium breast size.

Compliance with ethical standards

Conflict of interest Giacomo Datta, Antongiulio Mangia, Nino Nicolò, Maria Piera Mano, Stefano Bruschi, Maria Grazia Baù, Alessandra Surace, declare that they have no conflicts of interest.

Ethical approval All of the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all of the individual participants included in the study.

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Patient consent Patients provided written consent for the use of their images.

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