Two-year follow-up after delayed lipofilling reconstruction in breast cancer patients in terms of oncological safety and esthetic outcome

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Background
Lipomodelling after breast cancer surgery has emerged as a new technique of reconstructive breast surgery for correction of postsurgical defects in order to improve the esthetic results. Controversies exist on increased risk for local recurrence. Long-term follow-up is needed to evaluate the oncological safety of lipofilling.
Aim
This study aimed to conduct a 2-year follow-up of patients who underwent delayed lipofilling after different oncological surgical techniques to assess the oncological safety and esthetic outcomes.
Patients and method
Fifty female patients were admitted to the Medical Research Institute Hospital, Alexandria University, and underwent delayed lipofilling by means of Coleman's technique following operable breast cancer by mastectomy or breast conservative surgery between January 2012 and May 2013. They were followed up clinically and radiologically every 6 months for 2 years, and esthetic outcome was evaluated using patient and doctor questionnaires and the BCCT.core program.
Results
The mean time from oncologic surgery to lipofilling was 19.97 ± 12.74 months. The shortest period was 3 months, and the longest was 102 months. One (2%) case of local recurrence was detected 24 months after lipofilling. Esthetic outcome was evaluated by means of a questionnaire filled up by all patients and doctors, the results of which were compared with the results of the BCCT.core computer program. A pleasant and high level of satisfaction was achieved with the technique at the end of 2 years.
Conclusion
Lipofilling is a new and innovative reconstructive technique for correction of breast defects and maximization of the esthetic outcomes. The oncological safety is high with no evidence of increased risk for local recurrence with acceptable esthetic results for patients and doctors.

Keywords:
breast reconstruction, cancer breast, fat injection, follow-up, oncological safety

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Introduction

The effect of breast cancer surgery is usually physical but at the same time it has a psychological impact on the patient. Therefore, every effort is made to reduce the disabling effects of the ablative surgery and correct the deformity resulting from the operation [1–3].

Reconstruction following deformities resulting from breast conservative surgery (BCS) can be very challenging, especially following adjuvant irradiation damage, and sometimes contralateral symmetrization surgery may be the only option [4,5].

Lipofilling is also known as fat grafting or fat transfer or fat injection or lipotransfer. It is becoming popular among breast reconstructive and oncoplastic surgeons because of technical ease and simplicity. Two major steps are liposuction and lipoinjection. The fat specimen from liposuction can be prepared with various methods depending on surgeons' preference [2].

The indications for lipofilling technique for breast reconstruction are expanding. Most authors favor this procedure in delayed breast reconstruction to correct secondary defects after breast cancer reconstruction or to treat tissue damages and deformities after radiotherapy [5].

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There has been much debate on the optimal method for fat transfer, but until now there is no consensus on which method affords the best results with good long-term retention of graft volume and viability [6,7].

Autologous fat transfer is emerging as a useful adjunct for breast reconstruction. However, as with every new technique, much remains to be elucidated. Fat is easily available, harvesting involves minimal morbidity, and injection does not appear to have detrimental sequelae, although long-term follow-up, especially of radiological changes, is needed. This procedure reverses defects and allows modelling of other regions, both of which are good for morale and confidence, and especially so in the instance of breast cancer surgery [5,6].

Lipomodelling is based on introducing a transplanted graft capable of encouraging angiogenesis into a tissue bed that might harbor cancer cells. Inability to trigger neovascularization can be an important factor in maintaining dormancy, with vascular endothelial growth factor having a specific role in the initial tumor growth, and other angiogenic factors being able to maintain growth after attaining a certain size. These could be residual cells following the original surgery or other microscopic foci of invasive or in-situ disease [8–12].

Aim

The aim of this study was to conduct a 2-year follow-up of patients who had undergone delayed lipofilling after different oncological surgical techniques to assess oncological safety and esthetic outcomes.

Patients and methods

This study was carried out on 50 female patients admitted to the Surgical Department of Medical Research Institute Hospital, Alexandria University, who were operated for breast cancer by means of mastectomy or BCS between January 2012 and May 2013 according to ethical commoitte of our institute.

The patients were grouped into four categories according to the original operation:

(1) Group I: BCS.
(2) Group II: mastectomy.
(3) Group III: mastectomy+flap.
(4) Group IV: mastectomy+prosthesis.

Patients, after undergoing different oncological surgical interventions for breast cancer, with tissue defects and/or deformities, underwent delayed lipomodelling under Coleman's technique at least 6 months after completion of radiotherapy [1,2].

All patients signed an informed consent form that revealed the potential complications of infiltrating fat into the breast. They agreed to undergo routine postoperative mammography and ultrasonography and were informed that for optimal results and to minimize complications the procedure would often have to be staged (Figs. 1–4) [4,13].

Postoperative follow-up

Clinical follow-up

All patients were followed up for 24 months after the last session of the lipofilling: clinically every 6 months and radiologically using ultrasonography and mammography every 12 months.

Esthetic outcome

Patient and doctor satisfaction was evaluated after 6 months by means of a questionnaire.

For patients:

(1) Breast shape: better, very good, good, worst.
(2) Symmetrization: better, very good, good, worse.
(3) Does the patient need another operation.
(4) Sensitivity: normal, less, nonsensitive.

For the surgeons:

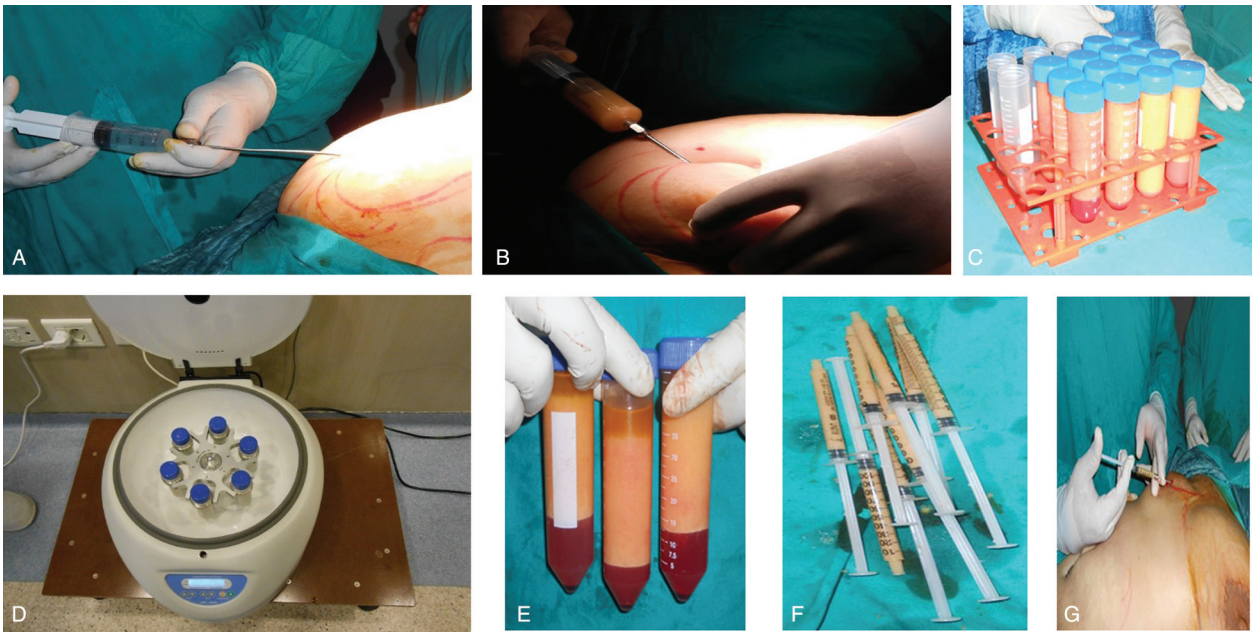
(1) Shape: better, very good, good, bad.
(2) Areolas: equal, slightly diverse, diverse.
(3) Symmetrization: symmetrical, slight symmetrical, nonsymmetrical.

The results were assessed by two surgeons by clinical examination and from the photographic records of each patient before and after the procedure.

Esthetic outcomes were evaluated by BCCT.core software under license and approval of the authorized institution who developed this program to evaluate the esthetic results objectively and automatically.

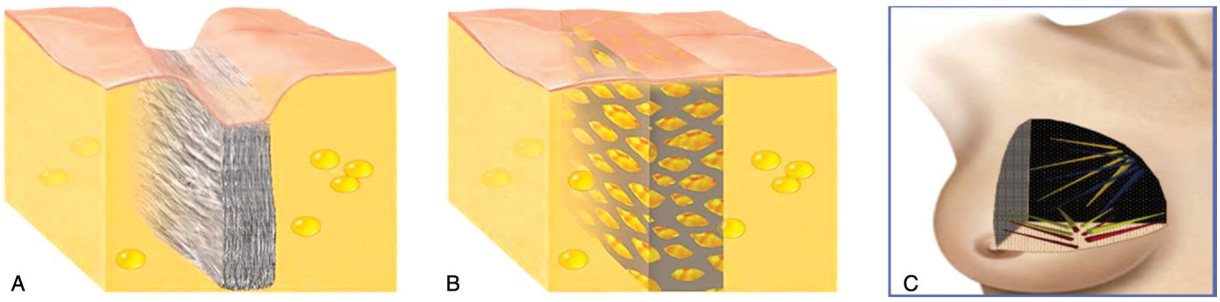
BCCT.core provides an extensive set of automated measurements that cover a broad range of items that reflect overall cosmetic outcome. Using digital marks on the nipples, axillae, and sternum jugular notch, this software automatically identifies the breast contour and carries out automated measurements, including breast shape, breast volume, deformity, nipple position, scar visibility, and skin changes. Using this range of items

Figure 1



(a) Infiltration of Klein's solution containing local anesthetic 10 ml lignocaine+0.25 mg adrenaline in 500 ml Ringer's solution. (b) Liposuction by slight negative pressure using a blunt-tipped Coleman's cannula (2 mm) mounted over a 50 ml Luer Lock syringe, Changzhou Medical Appliances General Factory Co., Ltd. (c) Fat harvested is transferred to a 50-ml Falcon tube ready for centrifugation. (d) After centrifugation at 3000 rpm for 3 min the fat is separated into three layers: (e) upper oily layer, middle purified fat, and lower blood and debris. (f) Purified fat is transferred into 3- and 1-ml Luer Lock syringes. (g) Fat injection using a 1-mm lipoinjection needle attached to a 1-ml syringe on withdrawal.

Figure 2



(a) Diagram showing how to spread the fat cell in different tunnels in different directions to obtain enough blood supply from surrounding structures. (b) Diagram showing how to spread the fat cell in different tunnels in different directions to obtain enough blood supply from surrounding structures. (c) Diagram showing how to spread the fat cell in different tunnels in different directions to obtain enough blood supply from surrounding structures.

and a four-point scale, the results reflect cosmetic issues that may arise following BCT and allow overall assessment of cosmetic outcome [13,14].

The claimed advantages of the BCCT.core software compared with subjective evaluation by doctor and patient include the fast and accurate reporting of results that were previously very time consuming. In addition, a reliable and automated approach to the assessment of cosmetic outcomes would enable comparison of results from different breast surgery units worldwide (Table 1 and Fig. 5) [14].

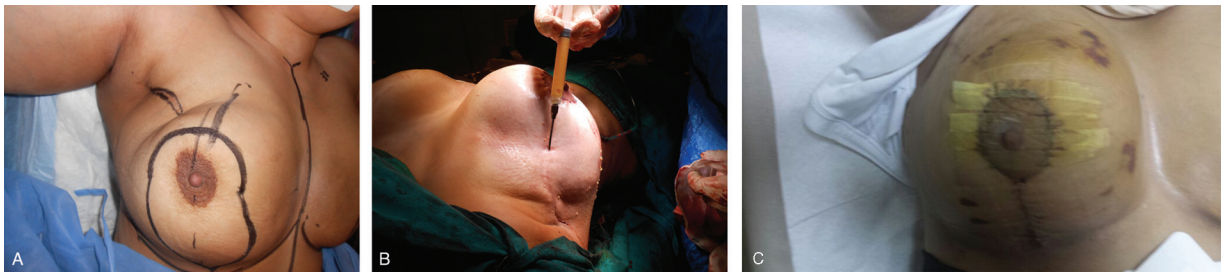
Results

This study included 50 female patients operated for breast cancer at the surgical department of the Medical Research Institute Hospital, University of Alexandria, between January 2012 and May 2013.

Sixty-five sessions were carried out in 50 patients who had undergone delayed lipomodelling.

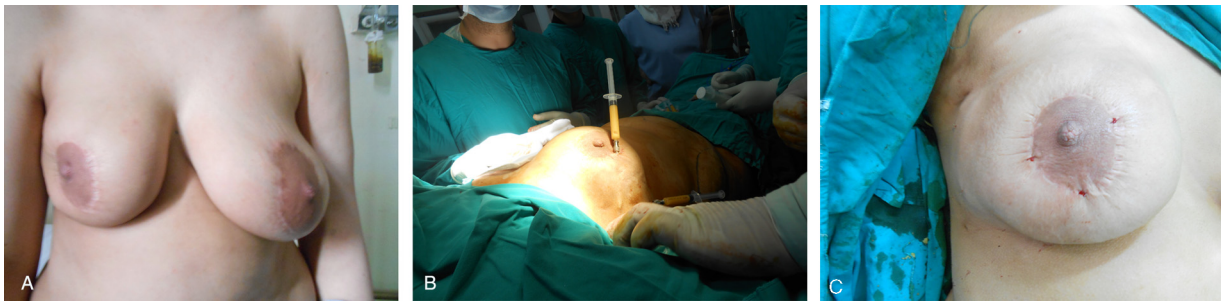
They were grouped into four categories according to the original operation:

Figure 3



(a) Case of conservative breast surgery with defect in the upper outer quadrant. (b) Injection of fat into the defect. (c) Postoperative picture after injection of 100 ml of fat.

Figure 4



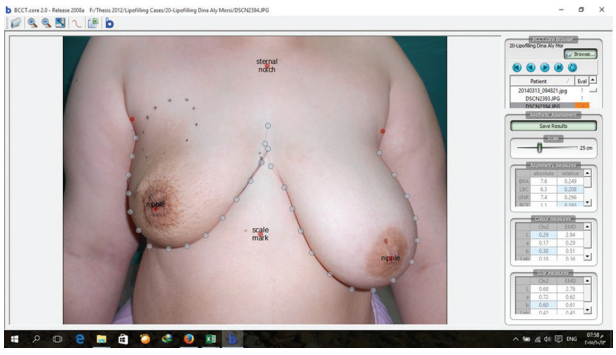
(a) Case of nipple-sparing mastectomy with defect in the lateral contour after radiotherapy. (b) Injection of fat into the subcutaneous region for correction of the defect. (c) Picture after correction of the defect and reshaping the contour.

Table 1 Harvard scale of cosmetic outcome (four-point Likert scale)

Excellent	Treated breast nearly identical to untreated breast
Good	Treated breast slightly different from untreated breast
Fair	Treated breast clearly different from untreated breast but not seriously distorted
Poor	Treated breast seriously distorted

(1) Group I: BCS, 10 cases.
(2) Group II: mastectomy, nine cases.
(3) Group III: mastectomy+flap, 16 cases.
(4) Group IV: mastectomy+prosthesis, 15 cases.

Figure 5



Preoperative image of the patient integrated into BCCT.core software.

Indications for lipofilling

More than one session was needed for some indications: contour remodeling in 34 (52.3%) sessions, symmetrization in 27 (41.5%) sessions, postsurgical defect correction in 18 (27.7%) sessions, and mask implant rippling in four (6.2%) sessions, complete breast reconstruction by lipofilling in 20 (30.8%) sessions, complete breast reconstruction by prosthesis and lipofilling in 21 (32.3%) sessions.

Time from oncologic surgery to lipofilling

The mean time from oncologic surgery to lipofilling was 19.97 ± 12.74 months; the shortest period was 3 months, and the longest was 102 months (Table 2).

Table 2 Time from oncologic surgery to lipofilling

Time	Group I ($n=13$)	Group II ($n=12$)	Group III ($n=20$)	Group IV ($n=20$)	Total ($n=65$)
Minimum–maximum	12.0–42.0	11.0–40.0	5.0–30.0	3.0–102.0	3.0–102.0
Mean ± SD	21.0 ± 9.08	20.25 ± 7.39	16.90 ± 6.60	22.20 ± 20.09	19.97 ± 12.74
Median	18.0	18.0	16.50	19.0	18.0

Table 3 Local recurrence after lipofilling

LR	Group I (breast conservative group) ($n=10$) [*N* (%)]	Group II (non-breast conservative group) ($n=40$) [*N* (%)]	Total ($n=50$) [*N* (%)]
No	9 (90)	40 (100)	49 (98.0)
Yes	1 (10)	0 (0)	1 (2.0)

LR, local recurrence.

Table 4 Patient satisfaction

Patient satisfactions	Group I ($n=10$) [*N* (%)]	Group II ($n=9$) [*N* (%)]	Group III ($n=16$) [*N* (%)]	Group IV ($n=15$) [*N* (%)]	Total ($n=50$) [*N* (%)]
Satisfied	2 (20.0)	3 (33.3)	7 (43.8)	8 (53.3)	20 (40.0)
Unsatisfied	1 (10.0)	2 (22.2)	4 (25.0)	2 (13.3)	9 (18.0)
Very unsatisfied	1 (10.0)	1 (11.1)	0 (0.0)	3 (20.0)	5 (10.0)

Table 5 Patient evaluation of results after lipomodelling (n = 50)

	Much better	Better	Unchanged	Worse	Much worse
Consistency	12	28	4	6	0
Size	15	20	11	4	0
Shape	9	21	15	4	1
Sensitivity	3	21	23	3	0
Quality of skin	7	33	8	2	0
Irregularities	13	25	7	3	2

Pathology

The pathology of the primary tumor was invasive ductal carcinoma grade II in 40 (80%) cases, invasive ductal carcinoma grade III in nine (18%) cases, and invasive lobular carcinoma grade II in one (2%) case.

Stage of disease

Fifty percent of the cases (25 cases) were stage IIB, 26% (13 cases) were stage IIA, 12% (six cases) were stage IIIA, 8% (four cases) were stage I, and 4% (two cases) were stage IIIB.

Local recurrence

Local recurrence (LR) occurred in one (2%) case (Table 3).

Patients satisfaction

Patient satisfaction was evaluated by means of two questionnaires completed by all patients. The first questionnaire assessed the overall satisfaction: 16 (32%) patients were very satisfied, 20 (40%) patients were satisfied, nine (18%) patients were unsatisfied, and five (10%) patients were very unsatisfied (Table 4).

The second one was a self-evaluation of results after lipomodelling as regards consistency, size, shape, sensitivity, quality of skin, and irregularities on a score of 1–5 (much better = 1, better = 2, unchanged = 3, worse = 4 and much worse = 5). The results were as follows: better in 34 (68%) patients, unchanged in 14 (28%) patients, and worse in two (4%) patients, with a mean score of 13.24 ± 3.72 (Table 5).

Table 6 Doctor satisfaction

Doctor satisfaction	Group I ($n=10$) [*N* (%)]	Group II ($n=9$) [*N* (%)]	Group III ($n=16$) [*N* (%)]	Group IV ($n=15$) [*N* (%)]	Total ($n=50$) [*N* (%)]
Excellent	5 (50.0)	1 (11.1)	4 (25.0)	3 (20.0)	13 (26.0)
Good	3 (30.0)	6 (66.7)	8 (50.0)	5 (33.3)	22 (44.0)
Fair	2 (20.0)	1 (11.1)	3 (18.8)	3 (20.0)	9 (18.0)
Insufficient	0 (0.0)	1 (11.1)	1 (6.3)	4 (26.7)	6 (12.0)

Table 7 Esthetic results on the basis of the BCCT.core program

Esthetic results by BCCT.core program	Group I ($n=10$) [*N* (%)]	Group II ($n=9$) [*N* (%)]	Group III ($n=16$) [*N* (%)]	Group IV ($n=15$) [*N* (%)]	Total ($n=50$) [*N* (%)]
Excellent	4 (40.0)	0 (0.0)	0 (0.0)	1 (6.7)	5 (10.0)
Good	4 (40.0)	3 (33.3)	11 (68.8)	5 (33.3)	23 (46.0)
Fair	2 (20.0)	6 (66.7)	5 (31.3)	5 (33.3)	18 (36.0)*
Poor	0 (0.0)	0 (0.0)	0 (0.0)	4 (26.7)	4 (8.0)
χ^2 (^{MC}P)	18.125 (0.007)*				

MC, Monte Carlo.
*Fair and good group

Doctor satisfaction

Doctor satisfaction was evaluated by two different surgeons by clinical examination and from the photographic records of each patient before and after the procedure. The results were excellent in 13 (26%) patients, good in 22 (44%) patients, fair in nine (18%) patients, and insufficient in six (12%) patients (Table 6).

Esthetic results by BCCT.core program

On using the BCCT.core program the esthetic results were excellent in five (10%) patients, good in 23 (46%) patients, fair in 18 (36%) patients, and poor in four (8%) patients. By Monte Carlo for χ^2-test, there was a statistically significant correlation between the esthetic results in different groups of patients ($P=0.007$) (Table 7).

Discussion

Breast cancer surgery deals with an important part of the female body, and every effort is made for safe removal of the primary tumor with preservation of esthetic results of the breast. Autologous flap, prosthesis, and different oncoplastic techniques are widely used nowadays, but in some patients the esthetic results are disappointing and need to be corrected. Usual corrective surgery is quite difficult and long. Lipofilling emerged as an easy and applicable solution in this regard [4,5].

Over the last two decades, lipofilling has become a widely used and important element in reconstructive techniques. Several studies have been published on the minor complications of techniques and their management. But there are few studies focusing on the oncological safety of the technique [1,4,6].

Through this study we aimed to determine whether lipofilling increased the incidence of LR and investigate the esthetic value of lipofilling after 2 years.

In our study we found one (2%) case of LR 13 months after lipofilling and 34 months after primary surgery (BCS). Our result was close to the retrospective cohort study performed by Petit *et al.*[15,16] at the European Institute of Oncology in Milan, Italy, that compared the LRR recurrence rates of 321 breast cancer patients who underwent lipofilling with the recurrence in 642 matched control patients from the same institute who did not undergo the procedure. Eight and 19 patients in each group had an LRR event, contributing to an LRR incidence rate of 1.15 and 1.36% per year [15,16].

We found another large study with a lower LR rate compared with our study that was performed by Rigotti *et al.*[17] and involved 137 mastectomy patients selected for analysis of oncological outcome with follow-up of 3 years. Only five LRs were reported (0.72% per year).

From an analysis of published trials from Europe and the USA we found that lipofilling has been used for reconstructive breast surgery in over 2000 patients. Unfortunately, no randomized controlled trial identified the oncologic risk associated with lipofilling, but no trial assumed any increase in LR

Table 8 Comparison of our study with other studies in the literature, including patient and doctor satisfaction

Summary of clinical studies of autologous fat grafting to the breast					
References	Patients	Indication	Follow-up	Doctor satisfaction	Patient satisfaction
Zheng *et al.*[18]	66 patients	Cosmetic augment (47), deformity correction (19)	13–61 months (37 months)	42.4% significant improvement, 36.4% moderate, 21.2% none	40.9% very satisfied, 39.4% satisfied, 19.7% not satisfied
Spear *et al*. [19]	37 patients (47 procedures)	Postsurgical deformity correction	3 weeks to 6 years (49 weeks)	21% substantial improvement, 64% minimal to moderate, 15% no improvement	NR
Yoshimura *et al.*[20]	40 patients (bilateral procedures)	Cosmetic augmentation	At least 19 patients with 6 months FU	At 6 months, all patients noted a volume increase of 100–200 ml	All satisfied with texture, shape, and softness
Coleman and Saboiero [21]	17 patients (bilateral procedures)	Cosmetic augment (12), deformity correction (5)	10–98 months (62.2 months)	Permanent and obvious increase in size reported after initial decrease	NR
Missana *et al.*[22]	69 patients (75 procedures)	Postsurgical deformity correction	1 month to 3.2 years (11.7 months)	86.5% very good, 13.5% moderate	NR
Cotrufo *et al*. [23]	42 patients	Postsurgical deformity correction/augmentation	Average FU 7 months, range NR	NR	NR
Zocchi and Zuliani [24]	181 patients (326 procedures – bicompartmental lipostructuring)	Cosmetic augmentation, postsurgical deformity correction	NR – but study conducted between 1998 and 2007	13% excellent, 69% good, 12% fair, 6% insufficient	23% excellent, 72% good, 6% fair, 3% insufficient
Pinsolle *et al.*[25]	8 patients (7 women, 1 man)	Poland's syndrome (only treatment in 1 patient, adjunct to other procedures in 7)	NR – study conducted between January 2003 to December 2005	NR	NR

FU, follow-up; NR, not reported.

after lipofilling in comparison with other control cases without lipofilling [16].

The esthetic outcomes of lipofilling were evaluated by means of a questionnaire filled by all patients, and through the doctors' evaluation of the results subjectively through photographic records of patients before and after the procedure and comparing the results with BCCT.core program results. We found that more than 70% of the patients were satisfied and there was a statistically significant correlation between patients' satisfaction and doctors' satisfaction ($P < 0.001$).

We compared our results with the results of other studies focusing on the esthetic outcome, and found that our result was close to theirs (Table 8).

Conclusion

Delayed lipofilling is an easy and perfect solution for the management of the sequelae of breast cancer surgeries. It can also be used as an alternative method for breast reconstruction in selected cases, with a higher rate of patient acceptance and compliance. As a day-surgery procedure with minimal complications to both recipient and donor sites, lipofilling is widely used and growing, but there is some debate about its oncological safety. Lipofilling may increase LR due to injection of adipocytes with stem cells that stimulate angiogenesis and promote cancer cell growth. None of the published trials in Europe and the USA on delayed lipofilling after breast cancer surgery with long follow-up in a large number of patients showed evidence of increased LR rate. Thus, lipofilling can currently be used with caution. However, prospective controlled trials with a control group of cancer patients with the same oncological characteristics and longer follow-up period should be conducted.

The subjective esthetic evaluation in the form of patient and doctor satisfaction and objective evaluation by the BCCT.core program showed high satisfaction rate after lipofilling. Therefore, we recommend this technique to maximize the esthetic outcomes.

Conflicts of interest

There are no conflicts of interest.

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