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Enhancing Breast Reconstruction: An Analysis of 117 Patients Undergoing Delayed Autologous Fat Grafting

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ABSTRACT

Background: The number of total mastectomy patients requesting breast reconstruction is increasing. However, many patients refuse this surgery because the procedures are too complex, too prone to complications, or even just because of the fear of breast implants and their long-term consequences. In this study, a comprehensive assessment of the results and complications of only fat grafting breast reconstruction is presented.

Methods: Between 2012 and 2021, 127 fat grafting breast reconstruction was performed in 117 patients who previously received total mastectomy. These included 70 cases of delayed breast reconstruction (DBR) and 57 "conversions," i.e., removal of a reconstructive implant replaced by iterative fat injections. The patients were fully informed about the procedure's risks and benefits before intervention. All the patients signed an informed consent. The procedure, complications, and results were analyzed on a regular basis every 3-6 months (average follow-up of 3 years).

Results: Data from 117 patients with a mean age of 59 years (25-83) were included in this study. The mean body mass index was 23 (19-30). Seventy patients had received radiotherapy before mastectomy (55%). An average of 3.17 injections (2 to 7) with an average volume of 300 cc were required to finalize the breast reconstruction, with a total average injected volume of 933 cc. Simple fat transfers were performed on an outpatient basis except for bilateral or associated procedures. In 48 cases (40%), the patients received appropriate procedures on the contralateral breast to make it symmetrical. Complications happened in 10 percent of cases, mostly minor complications like fatty cysts or much-localized Cytosteatonecrosis though in a limited number of patients, more serious problems with hematomas, abscesses, diffuse Cytosteatonecrosis or very extensive lymphoceles appeared.

Conclusion: The findings of this study support fat transfer breast reconstruction as a safe procedure with acceptably low complications, even in patients who have received radiotherapy in their history. Furthermore, this procedure can be applied in an outpatient setting. It seems that the application and the indications of this easy and feasible procedure will be increased in the coming years.

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INTRODUCTION

There has been an increase in requests for breast reconstructions by mastectomy patients.[1] However, due to its complexity and high complication rates, many refuse to undergo the surgery. Some of them are just afraid of breast implants and their long-term

consequences.[2-5] Iterative fat transfers meet this demand by their simplicity, especially since they limit the morbidity of donor sites when autologous reconstruction is desired.[6,7]

Some patients refuse the use of a silicone prosthesis for multiple reasons[8] and are reluctant to use flaps because of the complications and the cumbersome microsurgical procedures.[9] Reconstruction by exclusive fat transfer (EFT)- which is most often performed on an outpatient basis- is now an acceptable solution for these patients, even if three or four procedures at intervals of a few months are necessary.[10] Fat injections have proven to be effective thanks to their regenerative power on flap or prosthesis reconstructions as well as in the aftermath of conservative treatment, thanks to the integration of the fat into the scarred or sclerotic tissues, with an unequalled trophic effect.[11,12]

Two techniques dominate these reconstructions: breast prostheses and autologous flaps.[14] Fat transfers have become essential to improving and finalizing these breast reconstructions.[6,7,15] Implants, which represent more than 70% of reconstructions, have multiple advantages: rapid recovery of breast volume and good quality results; but there are multiple long-term defects including inconsistency, mobility and asymmetry of the reconstructed breast.[16]

Flaps do not have these shortcomings and are therefore often preferred to obtain natural and supple shapes, especially in patients who have undergone radiotherapy even years before.[17,23]

Unfortunately, these procedures are associated with high morbidity: partial or total necrosis of the flaps, significant pain and unsightly scars in the donor area.[18-20] In addition, this surgery is more time-consuming, requires training in microsurgery and makes rapid recovery in case of vascular complications possible.[21]

For these reasons, some surgeons have proposed this EFT technique in delayed breast reconstruction (DBR) or as a replacement for a prosthesis for more than fifteen years. Therefore, in the present study, a comprehensive assessment of the results and complications of only fat grafting breast reconstruction is conducted.

METHODS

Patient selection

One hundred twenty seven fat grafting breast reconstruction was performed in 117 patients between 2012 and 2021. The data of the patients has been reviewed retrospectively. The experience of the surgeon who did the operation for the first reviewed cases was 7 years, since this procedure was firstly done as the only method of breast reconstruction since 2005. All breast cancer patients who had previously undergone total mastectomy and received fat grafting procedure for breast reconstruction were included in the study. There was no limitation in inclusion criteria for previous radiotherapy, surgery, etc.

A contralateral reduction mammoplasty was performed in 39% of the cases for the following reasons: to reposition the contralateral areola, to reduce the breast volume to limit the number of fat transfers, or adapt the other breast's shape to that of the reconstructed breast.

Surgical Techniques

Fat collection

The fat is harvested without the infiltration of serum or adrenaline. There are multiple sites from which the fat can be collected: most often, the sample is taken from the sub-umbilical region; the second common place to collect from, would be the supraumbilical region. If the volume collected from the first two sites does not suffice, the fat from the inner and outer sides of the thighs will be used. In some cases, one might even need to collect fat from the knees, the back and the subaxillary region.

The number and order of the samples are pre-established with the patient at the beginning of her reconstruction, which will require 2 to 5 samples (3 on average) which will be taken 4 to 6 months apart over a period of 9 to 24 months.

A 4mm Mercedes type cannula is used (three orifices in a fan shape) with low pressure (30-40cm of H_2O). In general, 300 to 600ml of fat (for one breast) is removed through a recovery system in a redon drain (Braun type) with a capacity of 800ml. The collected fat is washed once or twice by adding 20 to 25% saline at room temperature. (Figure 1)

Then, the fat is distributed in 10cc "Luerlock" syringes (24 or 36 syringes) which are centrifuged for 30 to 60 seconds at 1000rpm. These centrifuged syringes have three phases: the lower one, close to the syringe orifice, is blood, the middle one is fat that will be kept for transfer, and the upper one is an oily liquid. After the evacuation of the two useless phases (lower and upper), the retained phase, i.e., the pure fat, is between 5 and 9cc/syringe (on average, 70 to 100cc for 12 syringes). (Figure 2)

This 300 to 600cc of fat collected allowed the preparation of 36 to 72 syringes, corresponding to a volume of 250 to 500cc reinjected into the breast to be reconstructed. The average time for this procedure was 60 minutes depending on the difficulties of collection and the total amount of fat reinjected. (Figure 3)

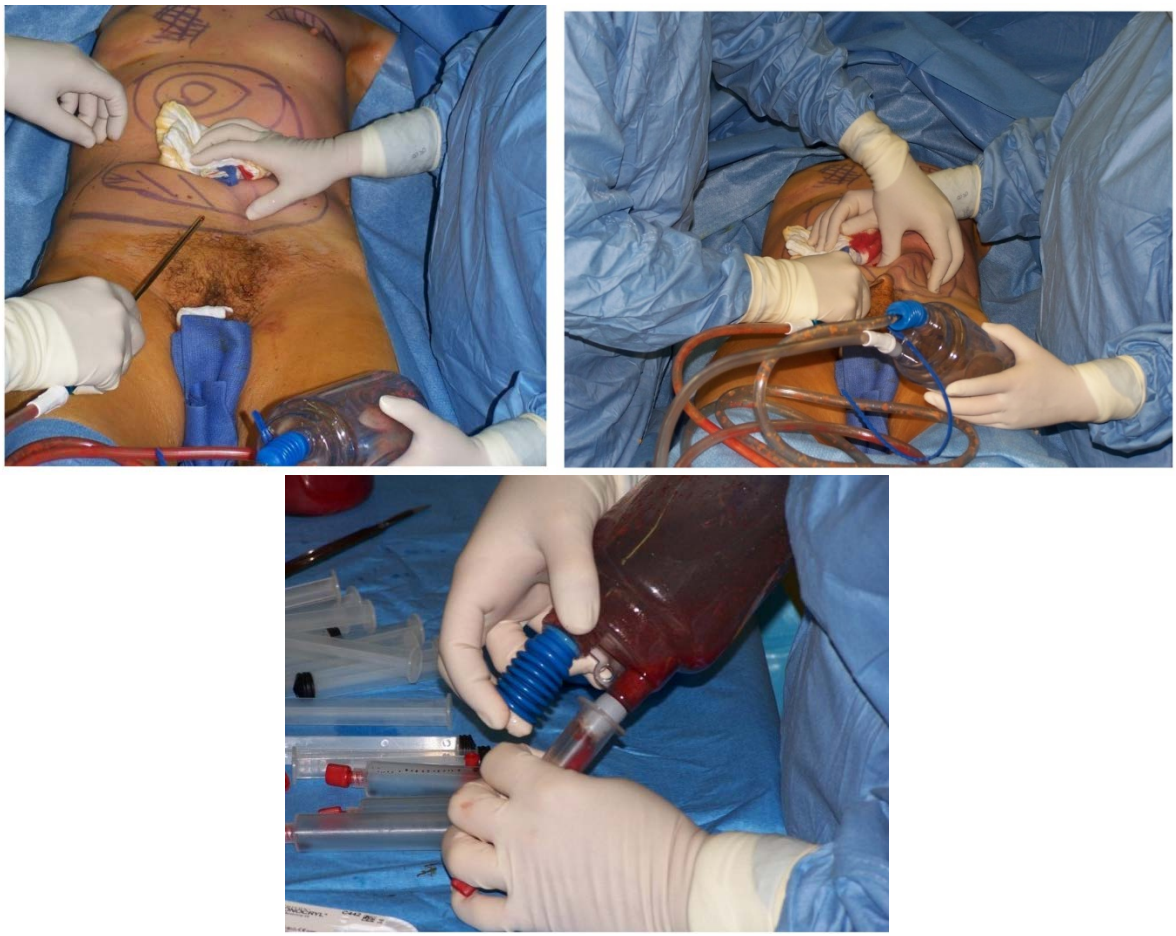

Figure 1. Harvesting the fat from the subumbilical region

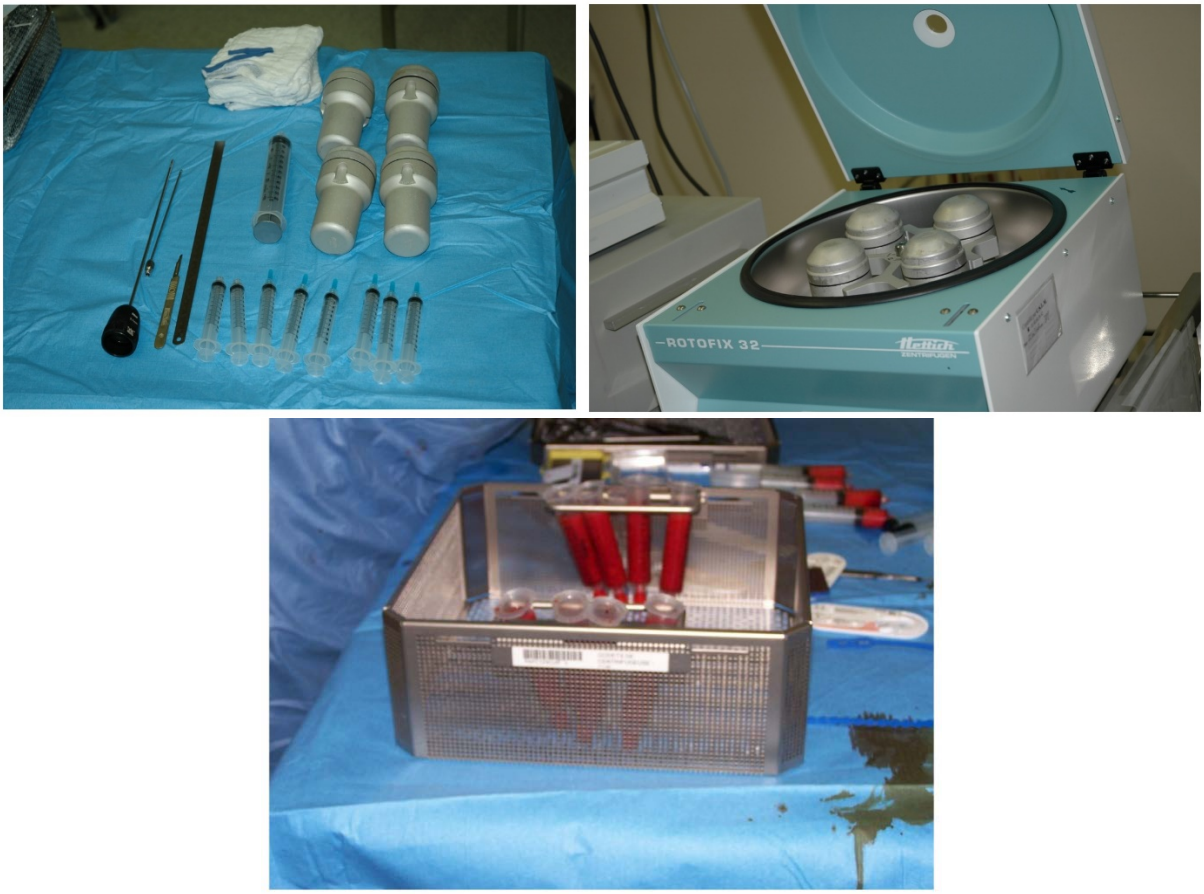

Figure 2. Purifying the fat by centrifuging the syringes

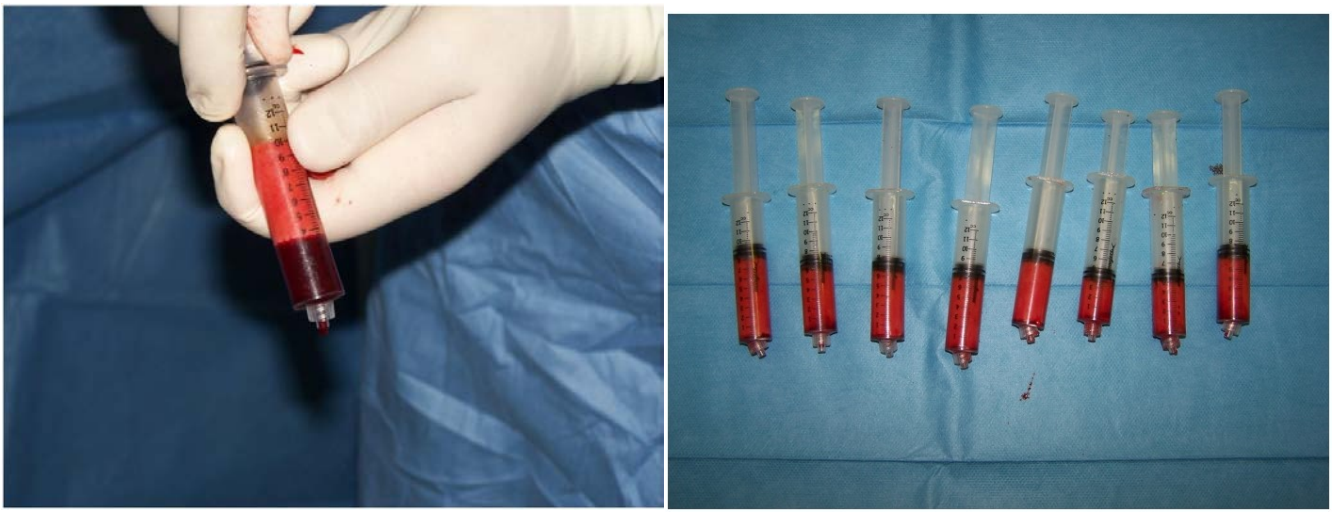

Figure 3. Evacuating the useless phases and keeping the collected fat after being centrifuged

Reinjection of purified fat

This technique depends on the clinical situation in which one finds oneself for this reconstruction. It is different in Immediate Breast Reconstruction (IBR), in DBR or in the removal of an implant-mediated breast reconstruction.

a) During the removal of a prosthesis, the fat will be injected between the skin and the peri-prosthetic capsule (which will be sharpened with an electrocautery in order to facilitate its adhesion with the help of a suction drain that is kept for 24 to 48 hours). The volume of the injected fat is often the same (200 to 400cc). Fasciotomies or "rigotomies" performed with a large sharp needle (18 gauges) are necessary in order to better distribute the fat, to cut the adhesions that prevent the skin expansion and to erase the surface defects. It is these "rigotomies" that will allow the breast to regain a shape adapted to its previous state. The edema created by the procedure will compress the space behind the implant site and thus limit the duration of the necessary drainage during the first stage of the operation.

b) In delayed breast reconstruction, the fat is injected into all the spaces between the skin and the ribs (therefore, also in the intra-muscular space) until the area is saturated, then multiple "rigotomies" are performed for the same reasons as in the previous case. The quantities injected are often the same, between 200 and 400cc depending on the surface treated, the skin adhesions, the existence or absence of previous radiotherapy and the habits of the operator.

The subsequent procedures will be the same in both cases, since after this first operation, the situation is similar in these two indications. The volume of the breast created by this first operation is variable, most often between 100 and 150cc.

We will increase this initial volume during each operation. The iterative fat transfers will be done most often on an outpatient basis and will make it possible to inject 200 to 300cc of pure fat at each operation, and then thanks to multiple "rigotomies" -which are essential- we will increase the volume in which the fat is distributed. The procedure is completed by injecting an additional 100 to 200cc into this space, which has become more flexible due to the cutting of the skin adhesions to the deep plane. This means that 250 to 500cc will be transferred into the breast, in 45 to 90 minutes at each operation, every 4 to 5 months. This period can be shortened in patients without radiotherapy. It is often lengthened in cases with significant after-effects due to radiotherapy or due to a previous surgical complications.

Between every two sessions, and at least 2 months after an injection, we often have patients prepare the treated area. This preparation is done by specially trained physical therapists who use a machine (Cellu M6 Alliance LPG system) that allows for "mechanotherapy". About ten sessions are needed to improve local trophicity, which facilitates fat transfer and the suppleness of the skin and deep tissues.[13]

Fat transfer is performed with a cannula of 1.5 to 2mm in diameter, with a single lateral hole at its tip and measuring 13 to 25cm depending on the areas to be treated. This cannula is used to deposit "filaments" or "spaghetti" of fat in different planes of the breast. The paths of these fatty filaments can be crossed by making two punctiform holes outside and inside. Multiple rigotomies are necessary to give the breast a normal shape and projection.

In order to analyse potential complications, the 130 patients were reviewed and minor and the most frequent complications as well as other rare cases including pneumothorax, hematomas of the reconstructed breast, abscesses, localized skin necrosis and encysted lymphocele were considered in the current study.

RESULTS

We included 117 patients in this study for whom 127 cases of fat grafting were executed. Seventy cases underwent DBR by exclusive lipofilling and 57 cases had surgery for conversions (exchange of the reconstruction prosthesis by fat). The values were identical in both groups: average age (59), BMI (23), bra size (between B and C).

In our study, 10% of the patients had a history of smoking. We had 69 cases who had a history of radiotherapy and 58 had no prior radiotherapy. For those with a positive history for radiation, 1010cc of fat injection was necessary compared to the other group which was 852cc (15% less). The mean volume by injection was 293 versus 307 and the number of injections was 3.5 surgeries versus 2.83 without radiotherapy (20% less for women not irradiated).

The total volume injected in the DBR group was slightly more than 985cc and the average injection in each session, was less than 290cc. In this series, 3.4 injections were necessary to finalize the reconstruction.

For conversions group, the average volume of the removed prosthesis was 300cc and the total injected volume was 880cc. The average volume per injection was 300cc and an average of 3.2 injections were required (2 to 6 injections). (Figure 4A-E) (Table 1)

In total, for the 127 cases, the figures are slightly different with an average of 920cc injected in total, 310cc per injection on average and 3.1 injections per patient. The average follow-up was 36 months.

Table 1. Comparing the volume injected in each group (DBR vs. Conversion, Radiotherapy vs. No Radiotherapy)

	DBR group (n=70)	Conversion group (n=57)	Radiotherapy (n=69)	No Radiotherapy (n=58)	Total (n=127)
Average injected volume in each session	290cc	300cc	293cc	307cc	920cc
Total injected volume	985cc	880cc	1010cc	852cc	310cc
Average injection times	3.4	3.2	3.5	2.83	3.1

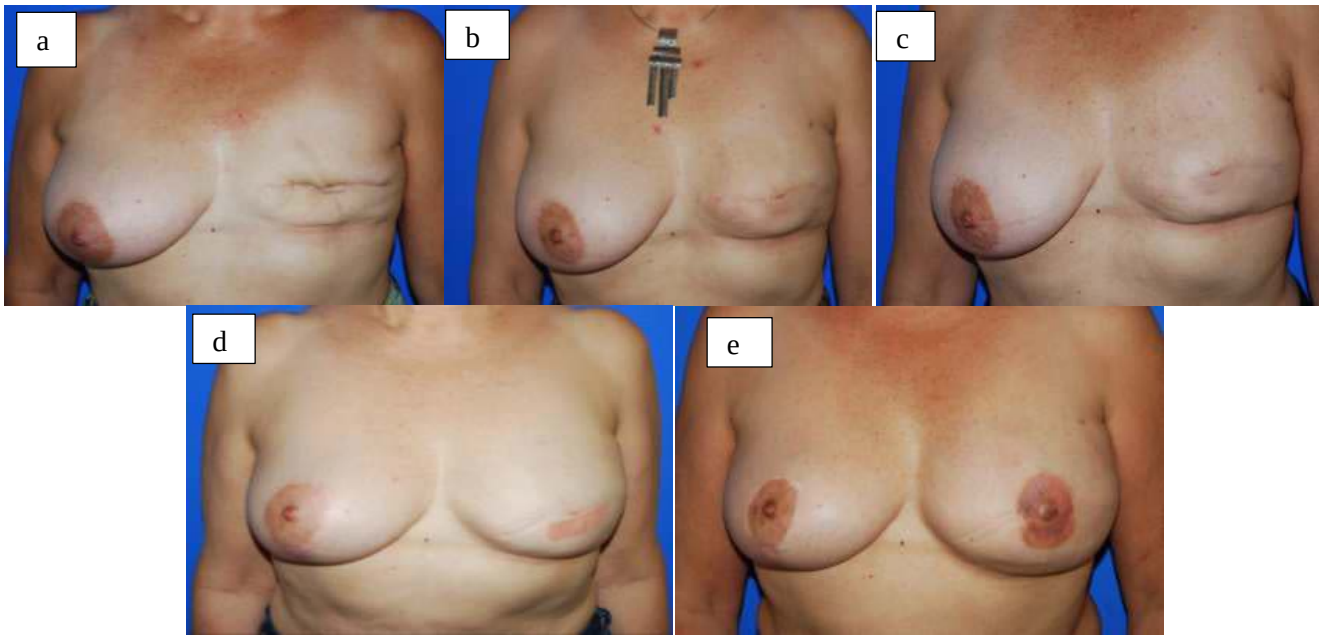

Figure 4. A patient undergoing EFT throughout a 3-year course of treatment

The most important complications included the following: (Table 2)

1. Pneumothorax: This is rare and its diagnosis is sometimes difficult when it is delayed by a few hours. A simple drainage of 24 to 48 hours solved this problem without further sequelae. Two cases of pneumothorax were recorded in our series of 127 patients in about 370 injections (1.6%), but the reconstruction was completed without any problem.
2. Hematomas of the reconstructed breast: There were four hematoma cases (3%) in this series: one in the SBR series and three in the prosthesis-to-fat conversions. In half of the cases, iterative

punctures resolved this complication (Figure 5); in the other half, the hematoma was emptied spontaneously, taking most of the fat with it. Three patients then resumed their reconstruction by lipomodelling, one was lost to follow-up.

Figure 5. Depletion of Hematomas by iterative punctures

3. Abscesses: there were four breast abscesses (3%), two major ones that required surgical drainage and two localized ones that disappeared after puncture and antibiotic therapy. (Figure 6)

Table 2. Important complications and their incidence rate in our study

Complications	Rate of incidence (n , %)
Pneumothorax	2, 1.6
Hematoma	4, 3
Abscess	4, 3
Localized skin necrosis	2, 1.6
Large encysted lymphocele	1, 0.8

Figure 6. Abscess in one of the patients as a complication of AFG

4. Localized skin necrosis: there were two cases of necrosis (1.6%), probably due to rigotomies that were too strong, due to the formation of a fatty lake. In two cases, surgical revision was not necessary, a simple puncture was sufficient. In the other two cases, a revision in the operating room with drainage was necessary (one of the patients had presented two infectious episodes in their history with removal of the reconstruction implant).
5. One case of a large encysted lymphocele (0.8%) required revision surgery to evacuate the collection and pad the reconstructed breast for further reconstruction.

One case of local recurrence and one metastatic recurrence were noted in the series. It was a contralateral lymph node recurrence, and a homolateral subaxillary recurrence. Also, one distant metastasis was diagnosed.

DISCUSSION

EFT is an optimal alternative for the breast reconstruction[10]; since it does not need major surgeries like in tissue flap reconstruction[9], or multiple delayed surgeries for prosthesis exchange; and it does not have a lot of late complications like in prosthesis surgery.[8] Also, this procedure can even be used in patients who have received radiotherapy even years before.[17,23] These fat transfers are increasingly used as a complement to breast reconstruction.[6] They allow to improve the reconstructions by reducing the reactions to a foreign body for the implants, but also by improving the scars, the shape and the flexibility of the reconstructed breasts. Almost all teams use them today as a complement, but few use them exclusively with iterative injections, without any other volume contribution.[22] This low complication rate and the disappearance of distant after-effects have resulted in a better acceptance rate of patients to undergo reconstruction.[6,7] The trophic effects of the injected fat also help to improve the tissues that are often badly damaged by radiotherapy and multiple local scars.[13]

We have been using this technique routinely since 2014. It provides excellent results comparable to those of flaps in the long term, both for the shape, flexibility and long-term stability of these breast reconstructions. Homsy *et al.*[26] and Piffer *et al.*[24] published their studies on total breast reconstruction with EFT, as in our study.

In Homsy *et al.*'s study (2010-2016), 38 women were included (41 breasts were reconstructed) who received a median of 4 injections (2-6) with a median injection volume of 200cc and a median total volume of 690cc (360-1350), with the median follow up being 2.1 years. Also, 44% underwent radiotherapy before

reconstruction,[26] whereas in our study the median volume for each procedure and total volume injected were higher (50% more: 300cc/injection and 900cc in total injected volume). Also, in our study we used fewer procedures and accomplished bigger breast sizes (900 cc compared for 600 cc). Also, they reported 7% oil cysts larger than 10mm as their complications. We did not encounter such complications in our study.

Aslo Piffer *et al.* (2021) showed us the same result: 37 cases with small breasts: cup A-B (less than in our study which was cup B-C). Also, 51% of the patients underwent radiotherapy, like in our cases. The median volume by injection was 257 cc and the total volume was 566.4cc with 2.2 injections/woman. They had a 18.9% comlplication rate[24], but we had a 11.1% complication rate (13 in 117 cases) which was less than the rate in this study.

The difference between the total volume in the DBR and conversion series in our study (985cc versus 880cc) was probably due to the percentage of radiotherapy we found in the DBR (65%) which was higher than in the implant conversion (50%) or because the skin expansion due to the implant reconstruction gave a better integration of the fat in the first injections.

Thanks to all these improvements, AFG is now an alternative to traditional breast reconstruction techniques. Since 90% of the procedures are performed on an outpatient basis, it is easy to understand why some patients are so interested in this type of reconstruction.

When properly explained to the patients, this technique allows for better adherence to the multiple operative steps. The results of this autologous technique are similar to those of flaps. This makes it possible to bring AFG up to the level of other reconstruction techniques, or even to replace them.[23] Numerous studies now prove that this technique is also reliable in terms of carcinology.[6,15,22,25]

Limitations

The only limitations of this technique are the quantity of fat in the patient's stock and the number of injections required (2 to 5 surgical procedures). We have improved the technique by increasing the average volume per injection, limiting the volumes to be reconstructed and symmetrizing the contralateral breast. We have managed to completely reconstruct these patients in two to four injections (three on average), which makes this technique more acceptable to the patients. Thus, an injection every 4 to 6 months, over a total period of 10 to 24 months, has allowed us to reduce the total duration of these autologous reconstructions.

CONCLUSION

The analysis of 117 patients undergoing delayed autologous fat grafting was considered in the present study. All these procedures were performed by a single surgeon in a center dedicated to breast reconstruction. Our findings suggest that AFG could be considered today as a total breast reconstruction technique with natural and stable long-term results. This technique is an alternative to musculocutaneous or microsurgical flaps with a much lower morbidity rate and therefore better patient compliance with the reconstruction process. Moreover, radiotherapy does not seem to be an obstacle to this technique. Radiation therapy seems to slightly increase the number of injections required by 10 to 20%.

We, therefore, believe that this technique will become more and more important in the range of techniques for total breast reconstruction after mastectomy. The inclusion of more patients, in more centers and a longer follow-up period should allow a better evaluation of this exclusive fat transfer technique. We plan to do a multicentric study with 500 patients as soon as possible.

FUNDING

No funding was secured for this study.

ETHICAL CONSIDERATIONS

Informed consent was obtained from all the patients.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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