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Adipose-tissue grafting to the post-mastectomy irradiated chest wall: Preparing the ground for implant reconstruction

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Summary *Introduction:* Breast implant reconstruction after radiotherapy carries a high risk of failure and complication. Nevertheless, it may be the only alternative for patients who are not suitable for autologous reconstruction or who refuse this option. As clinical and experimental studies have demonstrated that grafting adipose tissue (lipofilling) in an irradiated area improves the quality of the skin, we made the assumption that preliminary fat grafting of the chest wall might reduce the complication and failure rates of implant reconstruction by improving the implant coverage.
Patients and methods: From 2007 to 2009, 28 patients had fat transfer to the chest wall, prior to implant reconstruction. All patients had had mastectomy and irradiation for breast cancer. Lipofilling was initiated 6 months after the end of radiotherapy. The mean number of fat-grafting sessions was 2 (range 1—3). An average volume of 115 cc (70—275 cc) was injected each time. Once the chest wall's skin seemed to have gained enough thickness, implant reconstruction was performed.
Results: The mean follow-up period was 17 months. Three minor complications occurred. Implant explantation was performed in one case for exposition. The cosmetic results were good and very good in >80% of the cases.
Conclusion: This study points out the benefits of fat grafting to the irradiated chest wall prior to implant placement and demonstrates that lipofilling prepares the ground to implant breast reconstruction. This approach could be considered as an alternative to flap reconstruction for selected patients.

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Delayed reconstruction after mastectomy followed by chest-wall radiotherapy is a challenging situation for the plastic surgeon. One can choose either autologous reconstruction, with a pedicled or a free flap, an implant reconstruction or a combination of flap and implant. However, implant reconstruction after radiotherapy carries a high risk of failure, complication and poor cosmetic outcome, as radiation exposure induces deleterious modifications of the cutaneous and subcutaneous tissues.

Nevertheless, implant reconstruction may be the only option for patients who are not suitable for autologous reconstruction or who squarely refuse that option.

As clinical and experimental studies have demonstrated that grafting adipose tissue in an irradiated area improves the quality of the skin,[1,2] we made the assumption that preliminary autologous fat grafting of the radiated chest wall, prior to implant placement, might reduce the complication and failure rates of implant reconstruction and also improve the cosmetic results by enhancing the thickness and the quality of the implant coverage. The current study is the first series analysing the impact of fat transfer to the chest wall prior to implant placement on patients previously treated with radiotherapy.

Patients and methods

From 2007 to 2009, 28 consecutive patients (mean age: 45 years; 29—61 years) had autologous fat transfer to the radiated chest wall, prior to implant breast reconstruction. All patients had had previous mastectomy for invasive breast cancer followed by chest-wall irradiation, with or without chemotherapy and hormonotherapy.

Due to radiotherapy, the 28 patients included in this study presented poor local conditions that could not allow implant reconstruction: thin tissues over the chest wall, lack of skin laxity and altered skin and pectoralis major quality. Because of these post-radiotherapy sequelae, patients were initially offered flap reconstruction with latissimus dorsi, but all 28 patients in our series refused this option. The propounded reasons for their refusal were the fear of postoperative pain and their wish to avoid a scar located in the back. They were however offered autologous fat grafting prior to implant placement. All cases were discussed, before initiating the treatments, by a multidisciplinary team including surgeons, radiologists, radiotherapists and medical oncologists. Patients were informed that the oncogenic potential of adipose stem cells in patients with a history of breast cancer is currently on debate. They were also informed that one or more sessions of fat grafting could be necessary to enhance the thickness and the quality of the chest wall skin before implant placement. Moreover, patients were warned that if implant reconstruction, after fat grafting, was not possible or failed, the only reconstructive option would be a flap. All patients gave written consent before starting adipose-tissue transfer.

Surgical technique of autologous fat grafting

Autologous fat grafting to the chest wall was initiated at least 6 months after the end of radiotherapy. The mean time between the end of radiotherapy and the first lipofilling was 9 months (6—180 months). All patients were operated upon by the same surgeon (IS). Standard fat harvesting from either the abdomen, the inner aspect of the knees, the flanks or the buttocks was accomplished using a blunt-tip liposuction cannula (4 or 6 mm) and a ' fat trap' as described in an previous publication: we use a 400-ml sterile drainage bottle connected on one end to the liposuction cannula and, on the other end to the aspirating device.[3] The adipose tissue is collected in the drainage bottle, which serves as a fat trap. The fat was then processed by first dividing it into 10-cc syringes followed by centrifugation at a speed of 3000 rpm for 3 min. Then, the purified adipose tissue was isolated by removing the bottom layer of blood and a top layer of solvent fat.

The fat was then injected into the radiated area using Coleman's cannula and care was taken to disperse the fat in a uniform manner and in multiple layers. The adipose tissue was injected into the subcutaneous plane, the muscular plane and the retro muscular plane of the chest wall. As we systematically perform an abdominal advancement flap for implant breast reconstruction, the upper part of the abdominal wall was also injected with fat to obtain a regular skin surface in the area of the future lower pole of the breast.

When several sessions of autologous fat grafting were necessary, the average delay between two sessions of was 3.3 months (1—14 months). The mean number of sessions of lipofilling prior to implant placement was 2 (range 1—3). Nine patients had only one session of fat grafting, 15 patients had two sessions and four patients needed three sessions before implant placement. An average volume of 115 cc of fat (70—275 cc) was injected into the donor site each time.

Breast reconstruction

Patients were re-evaluated after each session of lipofilling for skin suppleness and laxity. Once the chest wall's skin seemed to have gained enough thickness and trophicity, implant breast reconstruction was performed. The mean period between the first lipofilling and implant placement was 6.7 months (range 1.6—21.3 months). The mean time between lipofilling completion and implant placement was 4.6 months (range 1.6—21.6 months). At the time of reconstruction, we achieved an advancement flap of the abdominal skin to increase the laxity over the implant. The inframammary fold was then created, symmetrically to the controlateral one, by incising the posterior side of the fascia superficialis of the advanced skin flap and by suturing the deep dermis of this flap to the chest wall using absorbable stitches. The implant was always positioned behind the pectoralis muscle in the upper pole of the breast and the skin flap, thickened by fat grafting in the lower pole.

Anatomic gel implants were used in 27 cases and an expander in one case (Becker 50, Mentorcorp, Santa Barbara, CA, USA). The average volume of the implants used was 300 cc (185—400 cc).

The different steps of our approach are presented in Figure 1.

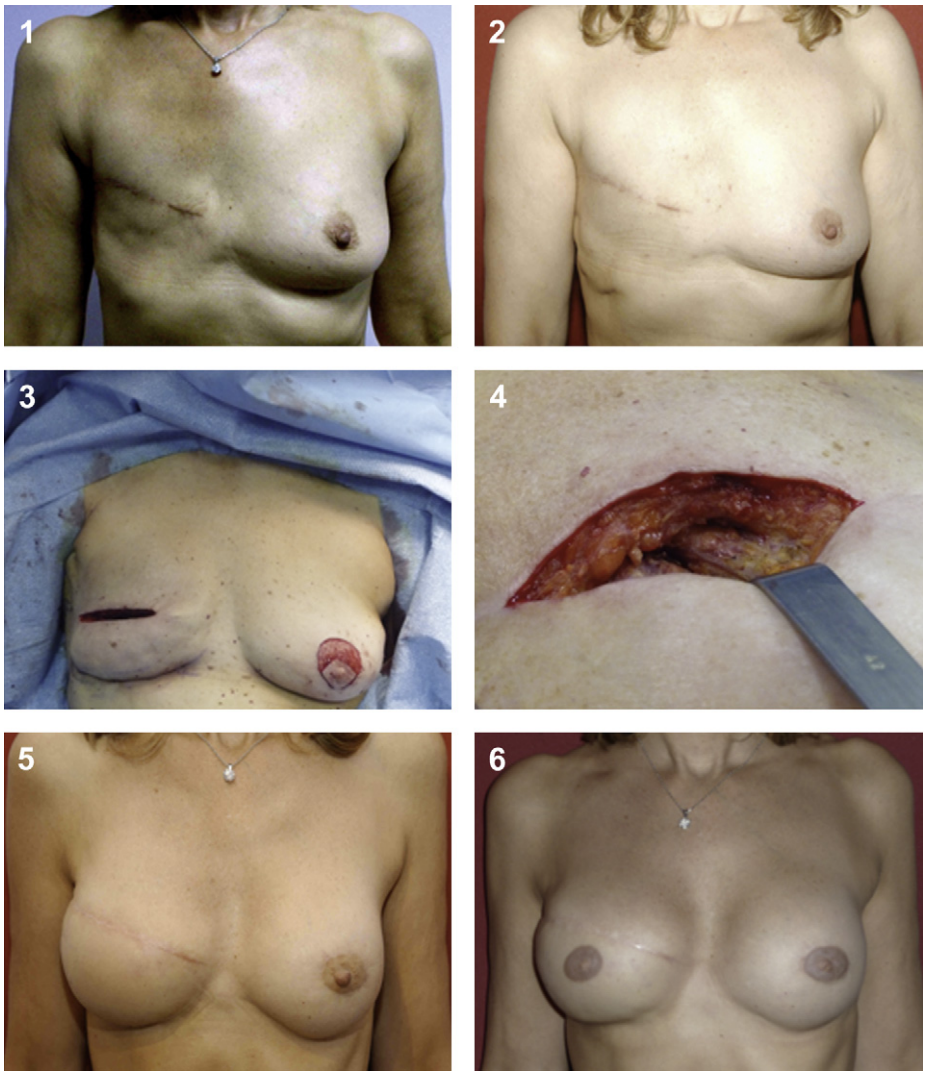

Figure 1 The steps of our approach to breast reconstruction after radiation 1: Chest wall prior to fat grafting 2: Chest after 2 sessions of fat grafting 3: Chest wall after abdominal advancement flap 4: Enhanced thickness of chestwall tissues 5: Reconstructed breast before areola tatooing 6: Reconstructed breast at the end of the whole process.

Controlateral symmetrisation was performed in 12 cases: breast reduction was done in five cases and implant breast augmentation in seven cases. These procedures were performed at the time of implant reconstruction in 11 cases and secondarily in one case.

Five patients underwent further operations for cosmetic reasons: two patients had supplementary fat grafting to enhance the cosmetic result of the breast reconstruction and three patients had a change of implant.

Follow-up

All patients were followed prospectively to record:

- the occurrence of local or distant cancer recurrence;
- any complication related to fat harvesting or injection;
- short-term (occurring during the 2 postoperative months after implant placement) or long-term complications of implant breast reconstruction (occurring later than 2 months after the implant placement); and
- cosmetic outcome, which was evaluated using a 5-point scale (1: bad to 5: very good) by two members of the surgical team and a medical assistant, as described in a previous publication.[4]

Results

Follow-up and oncological data

Follow-up length of the patients included in this study ranged from 4 to 34 months, with a mean follow-up of 17 months. No patient developed a local recurrence of cancer during the follow-up interval. One patient was diagnosed with a controlateral cancer and was treated by mastectomy.

There were no complications related to the autologous fat grafting itself for either donor or recipient graft site.

After implant placement, we did not observe any skin necrosis or infection. Four patients sustained short-term complications, all minor (four seromas). Two seromas resorbed spontaneously and one was aspirated at the clinic. One patient

with a chronical seroma developed a late fistula that lead to the exposition of the prosthesis and to explantation 6 months after implant placement.

With a median follow-up of 17 months, we did not notice any major capsular contracture (Baker 3 or 4).

Cosmetic evaluation

Both patient and surgeon were highly satisfied with the overall shape and appearance of the breast. The mean cosmetic score was 4.5 (3.5—5). More than 80% of the results of breast reconstruction were judged good and very good both by the patients and the surgical team (Figures 2—4).

Discussion

Our study is the first series that shows that, in selected patients, post-radiotherapy implant breast reconstruction can be performed safely and leads to satisfying cosmetic results after a prior autologous fat transfer to the chest wall. Fat grafting prior to delayed breast reconstruction literally prepares the ground for implant reconstruction.

Patients undergoing delayed reconstruction after mastectomy and radiation therapy to the chest wall represent a challenging subset of patients that requires careful preoperative evaluation. The published rates of revisions and complications for implant reconstruction following radiation ranges from 30.2% to 37% and 9.2% to 68%, respectively.[5—7]

In this group of patients, the implant coverage is poor, with a fibrotic muscle and a vulnerable skin due to radiation.[8] Thus, implant or expander reconstructions after radiation carry higher rates of complications and often lead to poor cosmetic results.[7] The ideal reconstruction for this group of patients is a flap, which brings distant non-irradiated skin to the area of reconstruction, allowing good cosmetic results and lower complications rates than implant reconstruction.[9—12] There are, however, patients who either refuse or are not acceptable candidates for flap transfer and for whom reconstruction with a prosthesis is the only possibility.[13]

Our approach relied on clinical and experimental studies that have demonstrated that autologous fat grafting enhances the quality of the skin. Rigotti et al. have shown that adipose-tissue transfer has regenerative effects on irradiated tissues.[2] Mojallal et al. conducted an experimental study, which has demonstrated that autologous fat grafting enhances skin quality and increases the vascularisation and the thickness of the dermis and the subcutaneous tissue.[1] However, we proposed, for irradiated patients who are at high risk of complication and poor cosmetic result, to perform autologous fat transfer to the chest wall prior to implant placement. One should specify that we only apply this approach to patients with thin, altered, chest-wall tissues with no laxity and who refuse flap-based reconstruction. However, when local conditions are satisfying, we achieve implant reconstruction without taking recourse to autologous fat grafting.

In our series, autologous fat grafting prior to implant placement seemed to be efficient in decreasing the complication rate of BR without inducing supplementary complications resulting from fat harvesting and injection. The complications were minor (four seromas) and only one patient (3%) sustained implant explantation, whereas the extrusion rate, found in the literature, for implant reconstruction after radiation is around 15%.[7] Thus, the complication rate of our approach is close to that of BR in a non-irradiated area.[7,14] The benefits realised with fat grafting may be attributed to the increased thickness and improved vascularisation of the overlying subcutaneous tissue and skin.[3] Last but not least, we did not observe any symptomatic capsular contracture (Baker 3 and 4) in this series. This observation might be explained by fat injection, as Panetierre et al. have observed a downgrading of a capsular contracture after fat transfer.[15] It might also be explained by the limited follow-up and number of patients included in this study. A longer follow-up is needed to confirm this promising data on capsular contracture rate.

The use of fat grafting in breast reconstruction is not new and many publications have shown that autologous fat transfer is efficient both for correcting breast-conserving therapy's sequelae and for improving the cosmetic results of post-mastectomy breast reconstruction.[16—20] However, publications on autologous fat transfer prior to breast reconstruction are scarce. We are aware of only one case report of the use of fat grafting prior to implant breast reconstruction in the literature:[21]

Serra Renom et al. used a different approach than ours: they performed fat grafting during the implant placement in 65 cases of post-radiation breast reconstruction.[22] By grafting adipose tissue initially, prior to implant placement,

Figure 2 Cosmetic result before areola tatooing. The patient had two sessions of lipofilling (90 and 140 cc) prior to the placement of a 200 cc implant.

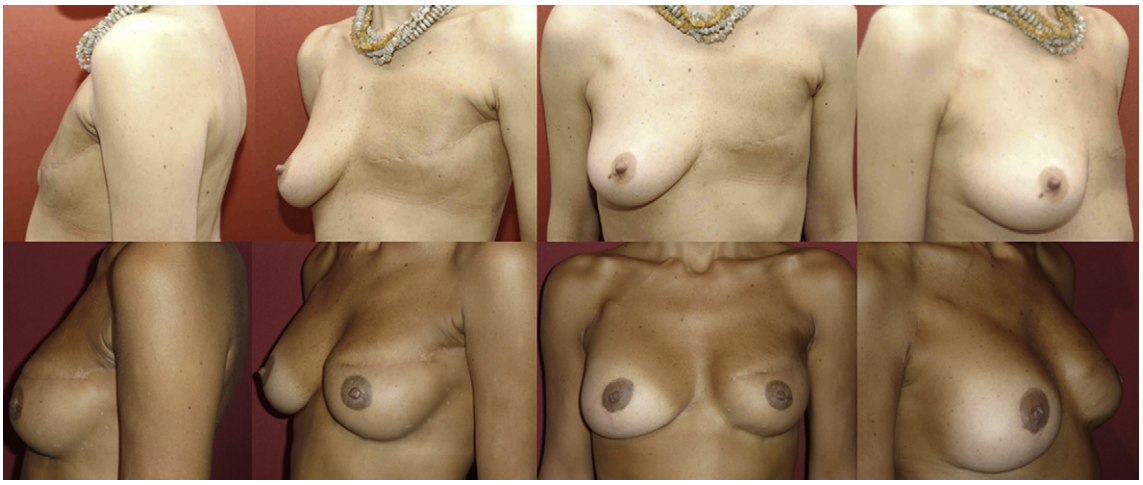

Figure 3 Cosmetic result at the end of the reconstructive process. The patient had 3 sessions of lipofilling prior to the placement of a 300 cc implant. She also had controlateral mastopexy and breast augmentation with a 100 cc implant.

we were able to inject in multiple planes (subcutaneous, intramuscular and submuscular) during successive operations (median = 2 (min: 1; max: 3)). Each injection literally prepared the ground for the next one. We believe that our approach may better optimise the regenerative effects of fat transfer than one session of fat grafting at the time of implant placement.

However, this technique presents several limitations. First, our approach requires several surgical procedures, whereas the use of a flap allows a complete breast reconstruction within a single step. Second, prior fat transfer 'delays' breast reconstruction as the mean period between the start of the reconstruction process and the implant placement was greater than 6 months in this series. This can be frustrating and patients must be warned of this

Figure 4 Pre and post operative pictures of 8 patients.

'multiple step approach'. Third, the multiple surgical procedures increase the costs of breast reconstruction when compared with single-step procedures. Last, the oncogenic potential of adipose stem cells in patients with a history of breast cancer is currently debated. There is a discrepancy between experimental studies, which have demonstrated that adipocytes can stimulate the proliferation of cancer cells,[23,24] and clinical studies, which did not show any increase of breast cancer recurrence after autologous fat grafting.[19,25] Nevertheless, our patients are getting a meticulous, prospective follow-up to evaluate the stability of breast reconstruction and to allow early detection of a local recurrence, should it occur.

Conclusion

This study is the first publication that demonstrates the benefits of autologous fat transfer to the irradiated chest wall prior to implant placement. In this series of 28 consecutive patients, who had been radiated, we were able to perform implant reconstruction with a 3% implant loss rate and good to very good cosmetic results in more than 80% of cases. This innovative technique could be considered as an alternative to flap reconstruction for patients who are not suitable to or who refuse this option.

However, further studies are still needed to confirm our observations and efforts should be continued to bring to light the full potential of autologous fat grafting in breast reconstruction, based on long-term prospective studies.

Conflict of interest

None.

Funding statement

None.

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