36 Symmetrization in Breast Reconstruction: Augmentation Procedures

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36.1 Introduction

Breast cancer is the most frequently diagnosed cancer in women, and breast reconstruction has been an integral part of the treatment with an increase of 20% since 1998 [1]. The rise in demand for reconstruction is also in parallel with the increase in bilateral prophylactic mastectomy procedures which are more likely to be followed by reconstruction [2].

Reconstruction has been shown to improve a patient's psycho-social well-being and decrease the amount of stress associated with mastectomy [3, 4]. Skin-sparing and nipple-sparing mastectomies combined with immediate reconstruction and refinements in reconstructive techniques have shifted the patients' expectations of breast cancer management from surviving breast cancer to achieving aesthetically pleasing results. The primary aim of any breast reconstruction technique is to create natural-appearing breasts with maximum symmetry. There are many studies depicting the proportions and shape of the aesthetically acceptable breast which outline the aesthetic concepts of breast reconstruction [5–10].

A natural breast, sitting on top of the pectoralis muscle between the second and sixth ribs, has a teardrop shape formed by the breast parenchyma, an intricate fascial layer, and the attachments which form the submammary fold.

The parenchyma, composed of glandular and adipose tissues, defines the structure of the breast, and changes in the parenchyma will determine the ptotic state of the breast. Moreover, breast shape is subject to dynamic changes with aging. Any choice of reconstruction, either autologous or implant-based, has to address these features. Thus, the choice of symmetrisation procedure mostly depends on the method of reconstruction of the index breast. Balancing procedures on the contralateral breast in the form of mastopexy, reduction, or augmentation became an integral part of breast reconstruction along with the volume adjustments of the ipsilateral breast.

Multiple factors should be taken into consideration when planning a breast reconstruction. From the reconstructive surgeon's standpoint, there are a few variables that determine the reconstructive scheme. Among these, the oncological treatment is the primary determinant of reconstruction.

36.2 Variables in Breast Reconstruction Planning

Mastectomy and breast-conserving surgery (BCS) are two main surgical options for ablation of the affected breast. The patient should discuss both options with the breast surgeon and the

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reconstructive plastic surgeon. Several factors play a role in the decision making such as tumor size to breast ratio, indication for radiation, location and centricity of the lesion, and the patient's motivation for a contralateral procedure.

36.2.1 Basics of Breast Reconstruction

Post-oncological breast reconstruction is basicly conducted in two steps: replacement or restoration of volume and refinement of the breast subunits. The timing and reconstructive methods are determined by several factors. The reconstructive plan is mostly dictated by the oncological treatment plan.

The oncological treatment includes the ablative surgery and adjuvant therapies; especially history of prior radiation therapy and plan for post-mastectomy radiation are the crucial determining factors. Radiation therapy has adverse effects on the cosmetic outcome and can cause increased postoperative complications. If the patient is scheduled to receive adjuvant radiation therapy, reconstruction plan and timing may be modified to avoid radiation-related complications.

The oncological scope of surgery, whether this involves unilateral or bilateral breasts, and the original size of the breasts are the main variables in determining the best reconstructive technique. It has been reported that patients with bilateral reconstruction, either with implants or autologous tissues, are more satisfied with the results due to improved symmetry [11]. Thus, bilateral reconstructions may be considered more favorable than unilateral reconstructions in terms of symmetrization.

Breast size is another major variable because patients with large breasts are more likely to be obese and have an increased risk of complications especially in implant-based reconstructions. Also, unilateral reconstructions are challenging in large-sized breasts since matching the affected breast to the unaffected counterpart in the long term is a difficult task. Therefore, breast size is another important factor that needs to be taken into consideration during reconstructive planning [12].

Understanding the sub-units of the breast is crucial to improve the results of reconstructive or aesthetic breast procedures [13, 14]. Placing the incisions matching with the subunits of the breast in order to hide unsightly scars is important to achieve attractive results. From a reconstructive point of view, the breast sub-units or landmarks which remain untouched during ablative surgery are valuable to create a natural-looking breast mound (Fig. 36.1).

The best material to create a natural-looking breast is the original breast tissue itself. This is only possible in cases of breast-conserving surgery where a sufficient amount of original breast tissue remains following the oncological surgery. In nipple- or skin-sparing mastectomies, the original breast skin with or without nipple areola complex (NAC) also serves as a perfect envelope to help achieve good aesthetic results. The reconstructive task is much easier in these cases since the precise outline and the footprint of the original breast is readily available and needs to be filled with the appropriate material for volume replacement. This is a common scenario in skin-sparing or nipple-sparing mastectomies including the bilateral prophylactic cases. It is also possible to keep these valuable subunits and landmarks in two staged reconstructions by using tissue expanders in the first stage (Fig. 36.2). The most difficult reconstructive task is in the case of late reconstruction where none of these sub-units or landmarks exist for shaping the new breast.

36.3 Symmetrization in Breast Reconstruction

The aesthetic challenges significantly differ between bilateral and unilateral reconstructions as mentioned above. Symmetrical results can be achieved more easily in bilateral reconstructions when performed with identical methods and timing. However, unilateral reconstructions require a more meticilous planning to achieve long-lasting and symmetrical results since the shape, structure, and the aging pattern of the contralateral

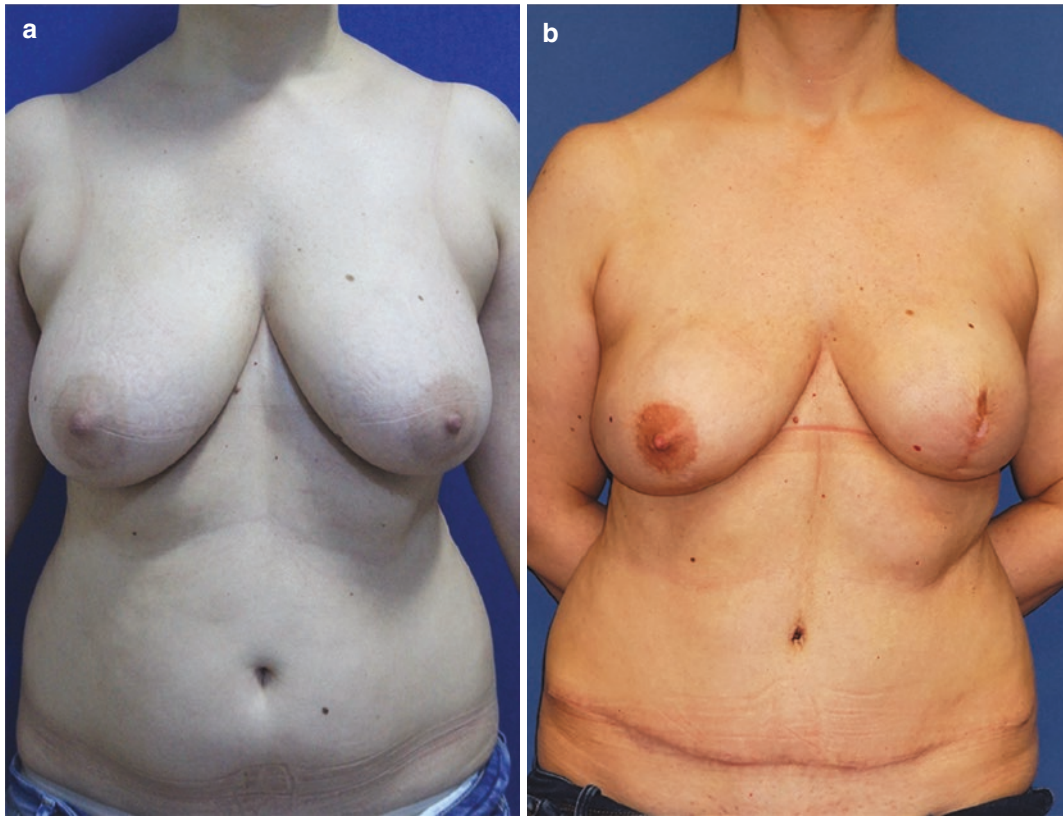

Fig. 36.1 Sub-units and landmarks of the breast which remain untouched during ablative surgery are valuable to create a natural-looking breast mound as in nipple-sparing (left breast) or skin-sparing (right breast) mastectomies. (**a**) Preoperative and (**b**) postoperative 8 months views of a 36-year-old patient who underwent immediate bilateral reconstruction with DIEP flaps. Although the sizes of both breasts were slightly reduced, to achieve natural-looking breasts with symmetrical volumes is important in bilateral reconstructions

breast plays an important role when choosing between the reconstructive options.

Primary breast asymmetries in bilateral cases or large contralateral breasts in unilateral reconstructions may be balanced by mastopexy or reduction procedures. If the patient is satisfied with the size and shape of the contralateral breast, then the main goal is to replace sufficient volume for a symmetrical outcome.

There are basicly three methods to replace the missing breast volume following ablative procedures:

(a) Reconstruction with autologous tissue
(b) Reconstruction with implants
(c) Reconstruction with the combination of autologous tissue and implants

Pros and cons of these methods for primary breast reconstruction have already been discussed in other chapters of this book. However, wound healing is a dynamic process and a reconstructed breast almost never preserves the exact same shape created at the operation. Autologous materials such as flaps or fat grafts are the best materials to create new breasts with natural consistency and aging. Breast shape is prone to change in time and symmetrization procedures are usually needed. We generally reserve implant reconstructions for patients with small breasts without any evident ptosis since the rigid structure of the implant capsule hinder natural ptosis of the breast in the long term (Fig. 36.3). Thus, it is reasonable to use implants bilaterally in the symmetrization procedures of unilateral reconstructions [15].

Fig. 36.2 It is possible to keep the original skin and footprint of the breast in immediate two-staged reconstructions utilizing tissue expanders and implants. A 39-year-old woman who underwent a two-staged immediate expander/implant reconstruction following right skin-sparing mastectomy. (**a**, **b**) Preoperative views; (**c**, **d**) Partially deflated tissue expander following over-inflation during radiation therapy; (**e**, **f**) Tissue expander exchanged with textured anatomic silicone gel implant

There is no optimal time for a revision surgery, and all cases should be individually considered for any revision. If the patient has received radiation therapy after the surgery, any secondary shaping procedure should be delayed for a minimum of 3–6 months following the completion of radiotherapy. If the patient has received chemotherapy after surgery, at least 4–6 weeks should be waited for an uneventful wound healing. Overall, physical examination reveals the optimal time for a secondary procedure. Lymphedema over the mastectomy skin and swelling of the flap should resolve, and the reconstructed breast should be completely soft to continue with any secondary procedures.

36.4 Augmentation Procedures for Breast Symmetrization

The simplest method to augment a reconstructed breast is with implants. The surgical technique is similar to cosmetic breast augmentation with

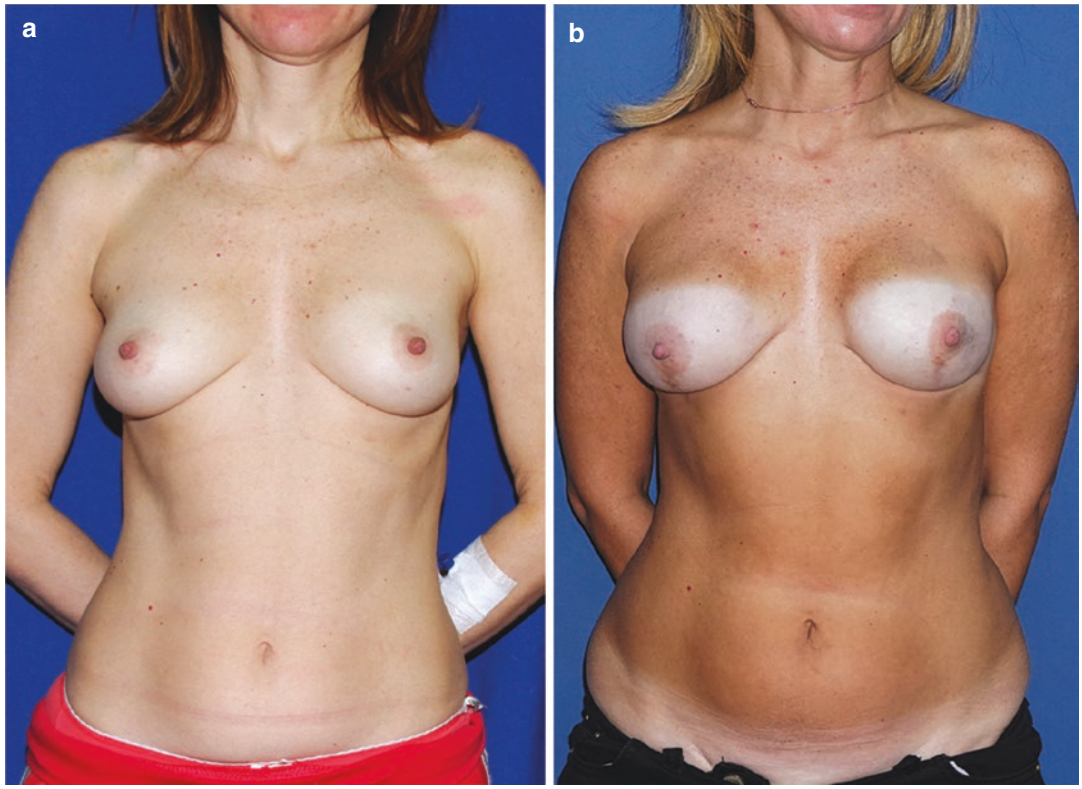

Fig. 36.3 Patients with small breasts without any evident ptosis are good candidates for primary bilateral reconstructions with implants. Immediate one-stage reconstruction of a 34-year-old woman who underwent bilateral nipple-sparing mastectomies with silicone-gel textured implants. (**a**) Preoperative, (**b**) Postoperative 1-year views

incisions through the pre-existing scars. The implants can be placed in the prepectoral or the subpectoral space depending on the thickness of soft tissue cover.

Augmentation with implants may not be a favorable option under irradiated soft tissue or insufficient skin envelope. Then, a flap including a skin component becomes a better choice for volume replacement and soft tissue support. Muscle or myocutaneous flaps provide durable coverage for the implants and adequate bulk for augmentation especially in secondary procedures.

Lipofilling, or fat injection to the breast, has been considered controversial regarding oncological safety for a number of reasons. Lumps following fat graft necrosis may mimic a recurrence. Moreover, there is a concern on the transferred fat grafts with in-vitro evidence of promoting the residual cancer tissues or stimulating the new growth of cancer cells [16]. On the other hand, clinical studies showing the safety and efficacy of lipofilling is increasing in number [17, 18]. Lipofilling of the reconstructed breast is more extensively discussed in the following chapter (Fig. 36.4).

Apart from minor contour corrections with a limited amount of fat injection, fat grafting in larger amounts in multiple stages to augment the soft tissue coverage over the implants also gained popularity. Technical refinements in fat injections provide natural consistency and durable soft tissue coverage over the implants (Fig. 36.5).

36.4.1 Augmentation of the Effected Breast

The choice of reconstruction depends on several different factors including the patient's body habitus, need for adjuvant radiotherapy, and the patient's personal preferences. Patients with thin body habitus but relatively larger breasts may not

have enough autologous tissue to provide the volume requirement. Another subset of patients who may need augmentation are again thin patients with preoperatively medium-to-large-size breasts (ie, C cup and larger), undergoing bilateral mastectomy with insufficient autologous tissue for bilateral reconstruction. Augmentation on these patients can be performed either only with flaps or with the combination of flaps and implants for larger volume replacement. Immediate breast reconstruction provides superior psychological benefit to the patient compared to delayed reconstruction. The preservation of inframammary fold as a valuable sub-unit additionally yields better cosmetic result.

Abdominally based free flaps generally offer a fair amount of tissue bulk to replace the necessary breast volume, and implants are rarely needed under these flaps. However, latissimus dorsi (LD) muscle or myocutaneous flap donor site has a limited soft tissue bulk despite its large flat muscle coverage. Thus, LD flaps are generally combined with implants in primary breast reconstructions. The shape and volume of the breasts depend more on the implant, in LD/implant reconstructions especially as the muscle atrophies in time. Secondary volume adjustments can be done easily by changing the size of the implant or by fat injections since the well-vascularized LD muscle flap provides a hospitable recipient site for the fat grafts.

Kronowitz et al. have reported better aesthetic outcomes with combined transverse rectus abdominis muscle flap (TRAM) and implant as compared to latissimus dorsi/implant reconstructions [19]. In their report they suggest that immediate placement of implants in TRAM reconstructions is associated with higher complications such as fluid collection around the implant as compared to delayed reconstructions. Figus et al. have also reported their experience with immediate vs delayed placement of implants combined with DIEP flaps [20]. They have not described significant complications with immediate augmentation of DIEP flaps and suggested better shaping and limited inadvertent damages to the pedicle with this technique. They have also underlined the importance of abdominal tissue in primarily determining the shape and volume of the breast.

Additional volume can be recruited by stacking deep inferior epigastric artery flaps (DIEP) or profounda artery perforator flaps (PAP) or combination of DIEP and PAP flaps for patients who do not wish to have implant placement. These are usually technically more demanding operations requiring a second set of recipient vessels. Most commonly used second set of recipients for this type reconstruction are now the retrograde internal mammarian vessels.

Breast-conserving surgery (BCS) is another treatment modality which gained more popularity as studies began to show similar survival rates to that of mastectomy [21, 22]. The procedure involves removal of tumor tissue with clear margins followed by adjuvant radiotherapy. The aim is to achieve cancer-free margins while preserving the healthy breast tissue for better cosmesis. This is an accepted treatment, especially for patients with non-multicentric, early stage cancer. Care should be given to patient selection. Conventional breast-conserving surgery is not ideal for patients with large tumor and a relatively small breast. Oncoplastic techniques have emerged to overcome the shortcomings of conventional BCS and also allowed a wider resection of the tumor with safe margins. In order to prevent poor cosmesis following large resections, breast tissue can be redistributed in a reduction pattern, or for patients wishing to keep their original size, pedicled flaps can be advanced into the defect.

There are several options available for volume replacement in BCS depending on the location of the defect (Fig. 36.6). Hamdi has classified the pedicled perforated flaps and their indications. According to this, thoracodorsal artery perforator (TDAP) flaps can be used for lateral, central, and superomedial quadrant defects whereas lateral intercostal artery flap (LICAP), due to shorter pedicle length, is usually considered for lateral quadrant defects [23]. Serratus anterior branch–based perforator flaps can also reach lateral and central quadrants. Medial quadrant defects are more challenging to reconstruct, but anterior intercostal artery (AICAP) perforator flap can reach inferior and infers-medial quadrants.

Another method is latissimus dorsi muscle flap/implant reconstruction combined with lipo-

Fig. 36.4 An increasing number of clinical studies support the safety and efficacy of lipofilling to correct contour deformities following breast reconstruction. (**a**) A 47-year-old woman who had previously undergone a right-side mastectomy and postoperative radiation; (**b**) 18-months follow-up of DIEP flap reconstruction of right breast; (**c**, **d**) Liposuction and fat injection planning to correct minor contour deformities. (**e**, **f**) Seven months after 130-cc fat injection to correct the upper-pole deformity of the right breast

filling. The capsule formed around the implant and well-vascularized muscle tissue provide a well-vascularized recipient site for graft take. Grafted fat not only augments the breast but also hides the visible implant edges and the wrinkling of skin. The fat grafting smoothens the transition areas and the general appearance of the implant-based reconstruction [24].

36.4.2 Augmentation of Contralateral Breast

The most commonly performed contralateral procedures are breast reduction, mastopexy, and augmentation mammoplasty. The timing and choice of reconstructive technique on the effected breast also dictate the possible contralateral pro-

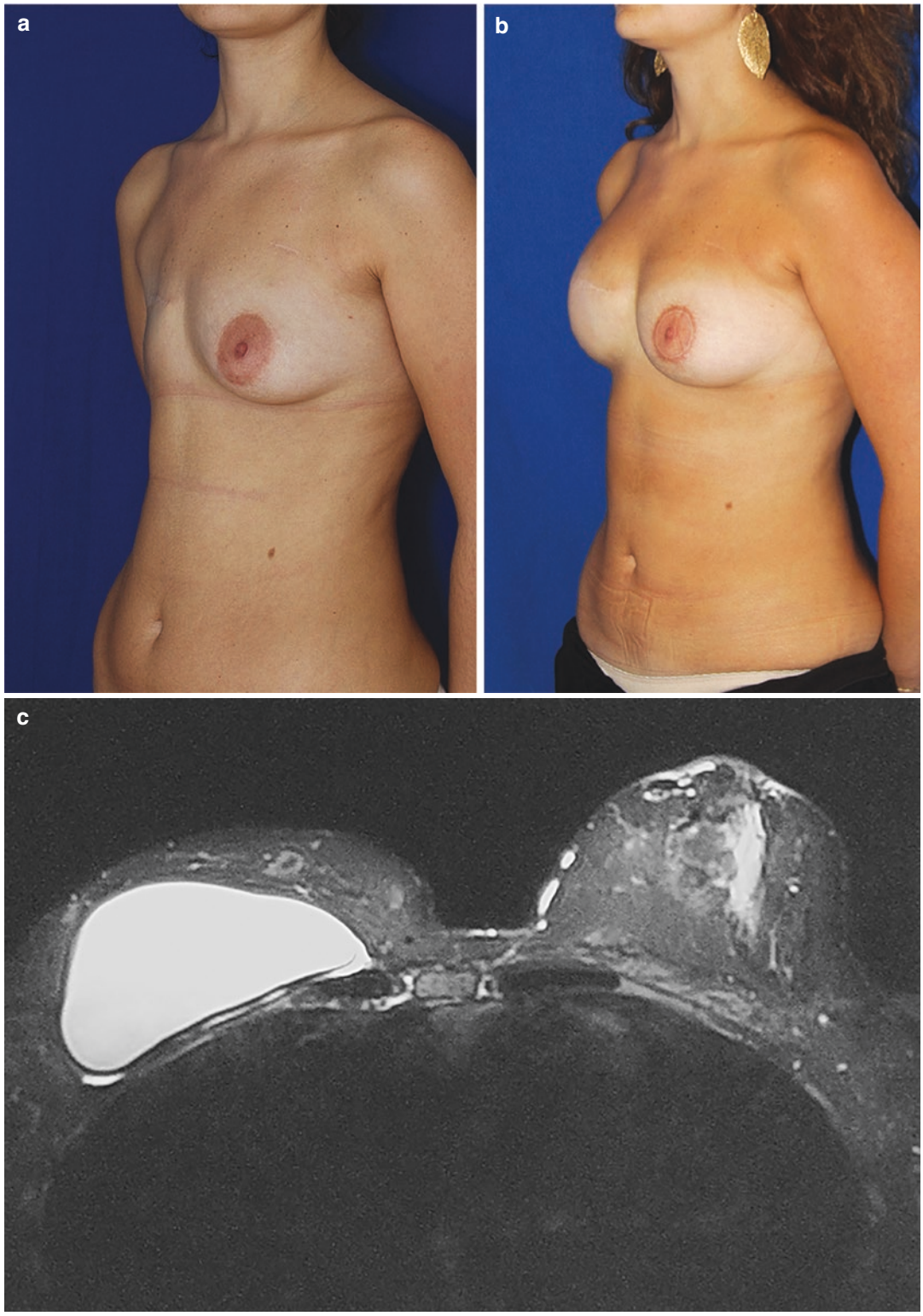

Fig. 36.5 Two separate sessions of fat injection over the implant provided a thick and durable soft tissue coverage in a 38-year-old woman. (**a**) Preoperative; (**b**) postoperative 2-year views; (**c**) radiological image obtained after fat injections

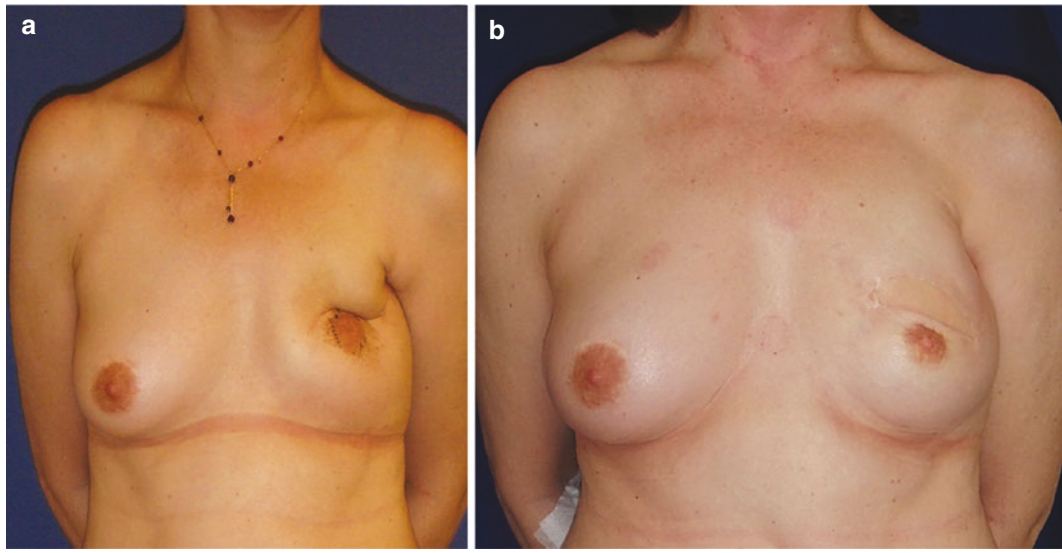

Fig. 36.6 (**a**) Breast deformity of a 54-year-old woman following BCS and radiation therapy. (**b**) Skin and soft tissue replacement with a DIEP flap

cedure. An increasing trend is reported for the contralateral prophylactic mastectomies.

Autologous techniques more frequently provide a reconstruction that matches to the opposite breast compared to the implant-based surgeries. This is mostly due to the inherent nature of skin/fat tissue which provides a more natural shape and ptosis. The evidence in the literature suggests that implant reconstructions are associated with more contralateral balancing procedures compared to autologous reconstruction [25, 26]. Additionally, delayed reconstructions, both autologous and implant-based, require more contralateral symmetrization procedures. On the other hand, implant-based reconstruction would give a more round and projected appearance which can only be matched with a secondary procedure on the contralateral breast. The same literature also shows that patients undergoing implant reconstruction are more likely to have a contralateral augmentation mammoplasty with an implant. Nahabediyan et al. have shown, on the contrary, that secondary procedures are more common following autologous reconstruction compared to implant-based reconstructions [27]. This is mostly attributed to an increased number of ipsilateral revision procedures on autologous tissue, such as fat and skin excision, rather than contralateral procedures.

When the untreated breast is smaller, ptotic, or the patient is dissatisfied with the size, augmentation mammaplasty may be considered (Fig. 36.7). Pre-operative planning is crucial to determine the extent of the surgery. The augmentation of the contralateral breast with an implant may follow the reduction, revision of the reconstructed breast. However if the implant is chosen as a method of augmentation for the contralateral breast, then it may be better to place another implant (even a small one) under the reconstructed breast to balance the volumes on both sides and provide a similar aging pattern. The decision to have a contralateral procedure rests with the patient. For patients who are not satisfied with their breast shape and size, recreating this shape on the reconstructed side will not provide desirable outcomes. Although contralateral augmentation is more common in implant reconstructions, Ulusal et al. have published their experience with simultaneous contralateral augmentation mammoplasty with autologous breast reconstruction [28]. Therefore for patients wishing a bigger size, simultaneously augmented contralateral breast will serve as a model for adjusting the shape and volume of the autologous tissue. Augmentation surgery on the contralateral breast is usually conducted using either (a) custom-made standard volume silicone/saline implants, (b) custom-made semi-inflatable implants (Becker) (c) Inflatable saline implants. Becker implants carry the advan-

Fig. 36.7 Bilateral breast augmentation of a 41-year-old woman with 225 cc silicone gel implants. (**a**, **b**) Preoperative views of the patient who had previously undergone TRAM flap reconstruction. (**c**, **d**) Postoperative 1 year

tage of both form stable implants and the possibility of volume adjustment.

The size and shape of the implant is selected based on the patient's and the surgeon's preferences. The technique of a standart augmentation mammaplasty procedure is followed. The implant may be placed either prepectoral or subpectoral planes. With the advances in imaging, breast implants evoke far less concern for tumor screening [29].

The ideal time to perform a contralateral procedure is controversial. Advocates of simultaneous intervention recommend using the corrected contralateral breast as a footprint for the reconstructed breast. This also decreases the recuperative time

and duration of discomfort for the patient. Operation room costs are lower. Furthermore, it also offers the opportunity for glandular exploration and sending specimen for histology to look for occult carcinomas on the contralateral breast. On the other hand, carrying out a delayed procedure may be more advantageous in achieving symmetry after adjuvant therapies are completed.

36.5 Conclusion

Breast reconstruction has been an integral part of the treatment of breast cancer surgery. Replacement or restoration of volume and refinement of the breast sub-units are the basic steps of reconstructive surgery. Symmetrical results can be achieved more easily in bilateral reconstructions when performed with identical methods and timing. However, unilateral reconstructions require a more subtle planning to achieve long-lasting and symmetrical results considering the dynamics of aging. Understanding the sub-units of the breast is crucial to improve the results of reconstructive or aesthetic breast procedures. The original breast tissue which is disregarded in mastectomy cases is the best material for reconstruction. Original breast envelope serves as an excellent guide for reconstruction in mastectomy cases.

The choice of reconstruction depends on several different factors including the patient's body habitus, need for adjuvant radiotherapy, and the patient's personal preferences. Autologous tissue or implants can be used for primary augmentation of the effected breast and lipofilling is a valuable instrument for secondary revisions. Delayed augmentation procedures may be more advantageous for contralateral breasts in achieving symmetry after adjuvant therapies are completed.

Tips and Tricks

- The priority in bilateral reconstructions is to achieve symmetrical and natural-looking breasts on both sides. The replacement of original breast size is of secondary importance in these cases.
- Fat grafts are not only favored as volume replacement materials but also improve the quality of the damaged tissue following radiotherapy. This is due to the angiogenic capacity of the preadipocytes, or stem cells, in the fat.
- Subpectoral placement of breast implants either with complete or with partial muscle coverage has been favored because of their lower risk of capsular contracture and safer implant coverage. However, complexity of the operative procedure, unfavourable cosmetic outcome, and animation deformity during the contraction of pectoralis major muscle are the serious drawbacks. Prepectoral placement of breast implants without detaching the pectoralis major muscle is a relatively new technique to overcome these problems. Form-stable silicone gel-filled breast implants wrapped with acellular dermal matrix (ADM) are placed in the prepectoral space to achieve more natural-looking breasts and appear to be a reasonable technical choice.

Conflict of Interest The authors have no disclosures or conflict of interest.

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