Breast Reconstructive Surgery

25

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Background

Breast cancer is the most common cancer in women worldwide [1]. Although the incidence varies widely according to race and age, it is estimated that approximately one in eight women (about 12.4%) will be diagnosed with breast cancer at some point during their lives [2]. Nevertheless, the overall survival rate has improved significantly in recent years and is currently about 80% at 15 years [3].

Surgery is generally the first line of attack in the therapeutic management of breast cancer, but evidence shows that mastectomy has a significant impact on patient self-esteem and body image perception [4–6]. For this reason, breast reconstruction after mastectomy is an integral part of breast cancer treatment as it will improve patients' quality of life [7, 8].

With recent technological advances and greater knowledge of anatomy, reconstructive procedures have been refined, and new techniques have been developed. The many surgical alternatives now available can be divided into those which involve prosthetic devices and those based on patients' own tissue.

Considering that each breast reconstruction technique has specific advantages and disadvantages, the same procedure may not be suitable for all patients. The choice of breast reconstruction technique will therefore depend on many factors, especially the patient's personal preferences and desired outcome.

25.1 General Considerations

The ideal goal of breast reconstruction is to replace the resected breast tissue with something similar to the natural breast in terms of size, shape, and texture. The reconstruction should also be stable over time and achieve symmetry with the contralateral side.

An important consideration to keep in mind during the planning process is the timing between mastectomy and breast reconstruction. Both immediate and delayed breast reconstruction are valid options. However, the decision must be

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made individually in order to guarantee oncological safety and to optimize functional, aesthetic results.

Immediate breast reconstruction is increasingly considered an option in patients undergoing oncologic breast surgery. Although it represents an additional procedure to mastectomy, performing the two procedures in a single operation provides a considerable psychological benefit by avoiding the emotional impact on body image after ablative surgery. Additionally, when the native breast skin envelope and inframammary fold are preserved, the reconstructed breast usually assumes a more natural cosmetic result (Table 25.1).

In contrast, delayed breast reconstruction can be performed months and even years after breast resection. It may be delayed for a number of reasons, including certain comorbidities and major risk factors such as advanced age, smoking, and vascular disease, or in case of doubts about local cancer control (Table 25.2). In the context of radiotherapy treatment, the timing is usually managed according to the protocol at each institution, and this will probably determine the choice of the reconstructive technique.

Taking these considerations into account, when deciding the most appropriate reconstructive technique, the surgeon should assess the type of mastectomy to be performed and the quality of the remaining skin. Whatever the case, an accurate preoperative evaluation of the patient's objectives and expectations plays an essential role when choosing the most adequate reconstructive technique. Therefore, so that surgical strategies and possible outcomes are discussed, and so that the patient's requirements are considered, it is essential that effective communication be established between the patient and the surgeon from the onset.

Table 25.1 Immediate breast Reconstruction

Advantages
• Single operation and one period of hospitalization
• Psychological benefit (avoid breast deformity)
• Better cosmetic results for nipple- or skin-sparing mastectomy
• Lower costs
Disadvantages
• Increased single operating time
• Possible difficulties of coordinating two surgical team when required (oncological surgery and reconstructive surgery teams)
• Possible changes in the reconstructed breast as a consequence of postmastectomy radiotherapy

Table 25.2 Delayed breast reconstruction

Advantages
• Unlimited time to think about reconstructive options
• Avoid the harmful effects of radiaotherapy on the reconstructed breast
Disadvantages
• Skin mastectomy flaps may result to be thin, scarred, contracted, or irradiated
• Requires additional surgery and recovery time
• Psychological effects of breast deformity until the reconstruction
• Additional surgical cost

25.2 Breast Reconstruction with Prosthetic Devices

25.2.1 Direct-to-Implant Reconstruction

Many different materials have been described for breast reconstruction after mastectomy, but the greatest advance with alloplastic materials occurred in the early 1960s when Thomas Cronin and Frank Gerow from the University of Texas, USA, developed silicone gel-filled breast implants [9]. However, complications associated with prosthesis implantation under the remaining thinned skin soon appeared. Cases of malposition, severe capsular contracture, and implant exposure appeared, and removal of the prosthesis was required.

In order to prevent such failures, in the 1970s, the first experiences in submuscular implant-based breast reconstruction after subcutaneous mastectomy were reported [10]. This approach consisted of placing the implant below the pectoralis major muscle and part of the serratus anterior muscle, and it became the chosen reconstructive technique for decades. However, despite the advantage gained by the implant coverage, the anatomical alteration of the muscle

was considerable. The postoperative period was more painful, and breast animation deformity was a displeasing drawback.

An important innovation in implant-based reconstruction took place in early 2000 when the acellular dermal matrix (ADM) was introduced in combination with a dual-plane subpectoral approach [11]. With this combined technique, the upper part of the implant was held under the pectoral muscle, while the lower part was supported by the ADM. However, the early ADMs were not well tolerated as their greater thickness hindered their integration into the skin flap and the dynamic deformity remained unsolved.

In recent decades, refinements in mastectomy techniques have allowed better vascular preservation of skin flaps. The tendency to relocate implants in the pre-pectoral plane has made it possible to avoid animation deformity [12]. Furthermore, the design of thinner ADMs has allowed better integration to the mastectomy skin flaps, making their use increasingly popular. By wrapping the implant with ADM, the implant is fixed in the mastectomy pocket, the inframammary fold can be easily rebuilt, malpositioning is prevented, the incidence of capsular contracture is decreased, and the aesthetic results are improved [13]. These benefits have changed the concept of implant-based breast reconstruction.

Key Point

The use of implants is the simplest approach and the most common method of immediate breast reconstruction in many institutions. It is mainly indicated for patients who undergo a nipple- or skin-sparing mastectomy but lack a suitable donor site for reconstruction with their own tissue and for those who do not want additional scars from the extraction of autologous flaps.

Women with small-to-moderate-sized breasts are good candidates for breast reconstruction with implants. Patients who undergo a bilateral subcutaneous mastectomy are also good candidates for reconstruction because the same volume of implants will be placed in both breasts, achieving more precise and permanent symmetry (Fig. 25.1).

25.2.2 Tissue Expander/Implant-Based Reconstruction

Two-stage breast reconstruction with a tissue expander and implant is another breakthrough from last century. The first clinical experience about the application of this technique was described by Radovan in 1978 [14]. The first stage of this procedure consists of placing the expander under the skin/pectoralis muscle and filling it progressively via transcutaneous injections with saline at regular outpatient visits. Once the desired volume has been reached, the second stage consists of replacing the expander with a permanent implant. The average expansion time can range from 2 to 6 months depending on the characteristics of the skin during expansion and the volume to be reached.

In 1984, a one-stage variant was described by Becker [15]. It consists of the use of a permanent double-lumen expander composed of an internal expandable compartment surrounded by a cohesive silicone gel compartment. Once the expansion is completed, the reservoir or valve can be removed and converted into a conventional breast implant, thus avoiding the need for a second operation to remove the expander and replace it with a permanent prosthesis.

Key Point

The two-stage breast reconstruction remains the technique of choice for many reconstructive surgeons. It is mainly indicated in patients who have insufficient remaining tissue after mastectomy to achieve full coverage of a direct-to-implant breast reconstruction and who do not prefer breast reconstruction with autologous tissue (Fig. 25.2).

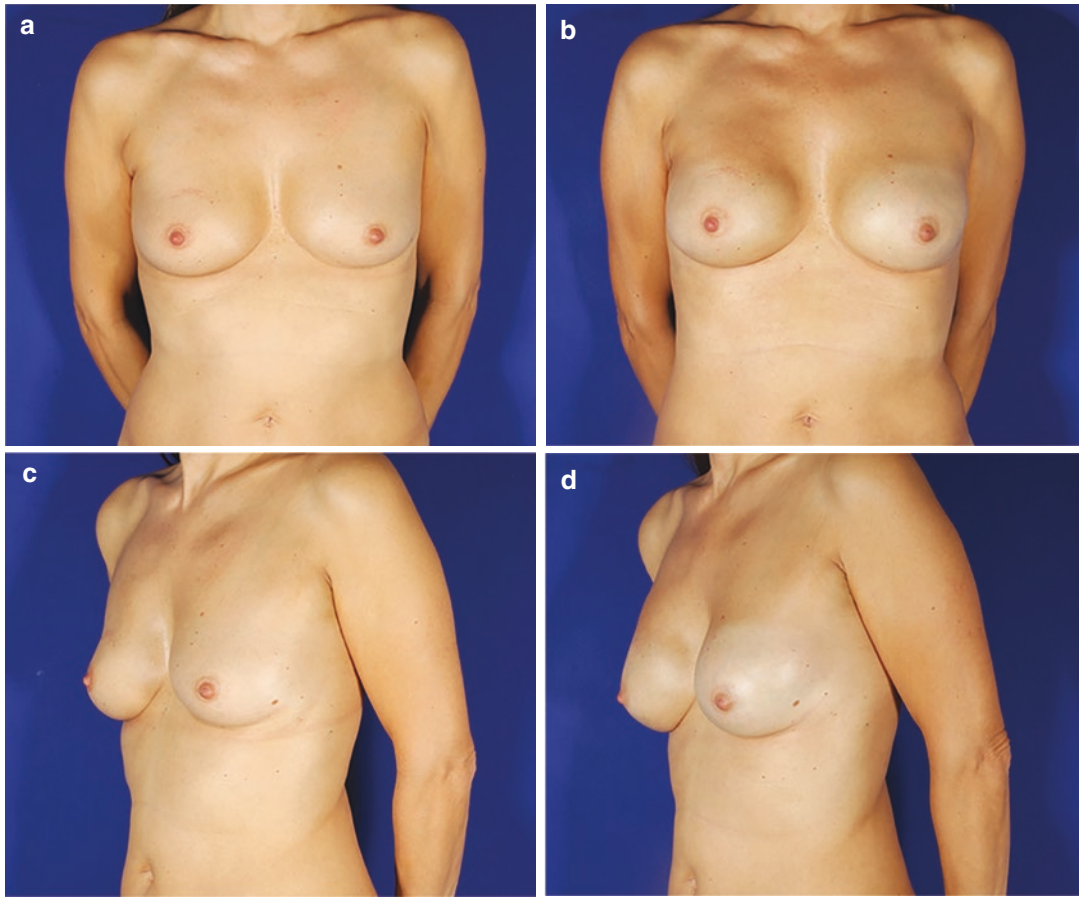

Fig. 25.1 Breast reconstruction with prepectoral implants wrapped in ADM, following bilateral subcutaneous mastectomy. Preoperative (**a**, **c**) and postoperative (**b**, **d**) images

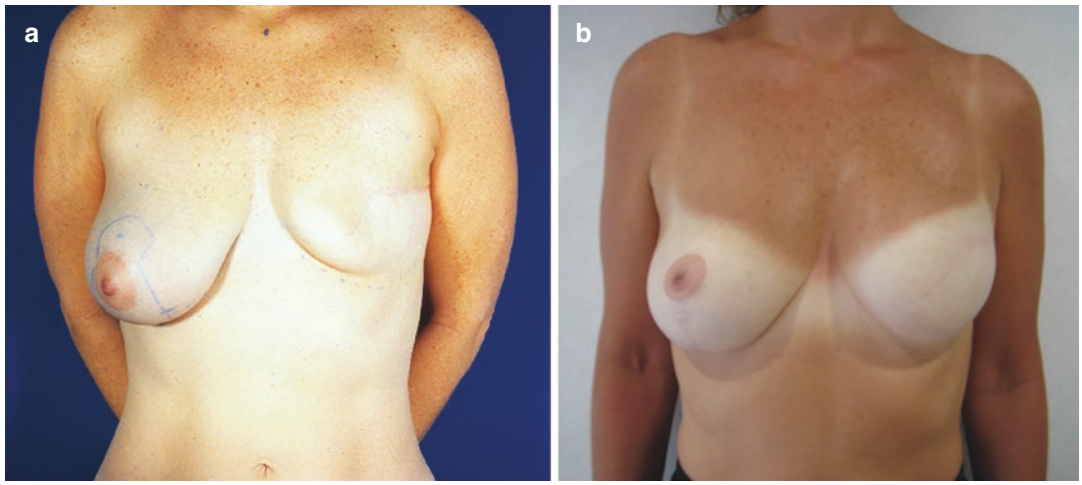

Fig. 25.2 Tissue expander/implant-based reconstruction of the left breast and mastopexy of the right breast. Preoperative (**a**) and postoperative (**b**) images

25.2.2.1 Limitations

Although breast reconstruction with prosthetic devices offers specific advantages—such as the reduced surgical time, the simplicity of the technique, minimal scarring, easier postoperative recovery, and faster return to normal activity—several limitations should be taken into account when using these techniques.

First, implant-related complications, such as capsular contracture, rippling, malposition, and implant rupture, lead to the need for a higher rate of reoperations for adjustment and symmetrization [16]. Permanent monitoring of the implants is therefore needed not only to ensure their integrity and position but also to confirm the absence of fluid accumulation (late seroma) because certain types of breast implants have been associated with anaplastic large cell lymphoma (BIA-ALCL), particularly those with textured surface [17]. In addition, breast implants are foreign objects that gradually deteriorate and will require replacement surgery within 10–15 years.

Second, breast implants are not recommended for patients who have received or will receive radiotherapy because irradiated tissue is weakened, very thin, and less vascularized. These conditions can lead to a higher rate of capsular contracture, malposition, and even skin flap deterioration with subsequent extrusion of the implant, thus producing highly unfavorable aesthetic results [18].

Third, another drawback of breast reconstruction with implants can be observed in patients with large breasts and those with certain ptosis. In such cases it is necessary to perform not only a skin-reducing mastectomy to lift the breast, but also symmetrization surgery of the contralateral breast (Fig. 25.2).

Nevertheless, the most important long-term limitation of implant-based reconstruction is that the breast will not have the same consistency, texture, or temperature as the natural breast, and it will not evolve harmonically over time. Age and gravity cause a loss of skin elasticity which will modify breast shape. As these changes will not occur naturally in implant-based reconstruction, in cases of unilateral reconstructions, the postoperative symmetry achieved between the healthy breast and the reconstruction decreases over time.

Regarding the tissue expander technique, the disadvantages include frequent outpatient visits to gradually fill the expander, discomfort associated with tissue expansion, and the need for an additional procedure to replace the expander with the permanent implant. Again, application of this technique in an irradiated breast is not advisable due to the relatively high rate of early and late complications (Table 25.3).

Table 25.3 Breast reconstruction with prosthetic device

Advantages
• Simple and less invasive technique
• Short surgery and stay in hospital
• Faster recovery and return to normal activity
• Minimal scarring (only in the breast area)
• Symmetrical and stable results in bilateral reconstructions
Disadvantages
• Difficulty in achieving symmetry in unilateral cases
• The implant does not evolve in the same way as the natural opposite breast
• Implants do not change to match variations in body weight
• Poor cosmetical result in irradiated skin
• Poor response to postmastectomy radiotherapy
• Possible unnatural results
• Requires implant maintenance and exchange
• Additional surgery in case of two-stage expander and implant-based reconstruction
• More long-term complications (capsular contracture, malposition, rupture, rippling)

25.3 Breast Reconstruction with Autologous Tissue

In recent decades, breast reconstruction has seen a shift toward the use of the patient's own tissue to recreate a more natural breast. In effect, breast reconstruction with autologous tissue is currently considered by many surgeons the best reconstructive choice that can be offered to patients.

The main advantage of this type of breast reconstruction is that the transferred tissue has a natural appearance that ages naturally over time. In addition, with the absence of alloplastic mate-

Table 25.4 Breast reconstruction with autologous tissues

Advantages
• Use of own tissue
• Easier symmetry in unilateral cases
• Natural appearance and feeling breast that change with the patient over time
• Possibility of recovering breast sensivity
• The breast will gain and lose volume with body weight variations
• Longevity of the reconstruction
• Better tolerance of postmastectomy radiotherapy
Disadvantages
• Technically more demanding
• Additional scar in the donor site
• Longer surgery and hospital stay
• Longer recovery
• More short-term complications (partial or complete flap failure and donor-site morbidity)

rials and their potential complications, the autologous tissue reconstruction can last forever, allowing the patient to completely forget about the distressing event of breast cancer.

Breast reconstruction with autologous tissue, however, is technically more demanding, and operating time, hospitalization, and recovery take longer. Although the success is very high in the hands of experienced microsurgeons, this technique is not exempted from short-term complications that can lead to partial or total flap failure or to morbidity at the donor site, such as wound dehiscence, weakness, hernia or bulge, seroma, and contour deformities (Table 25.4). The tendency to perform unilateral or bilateral mastectomy and immediate reconstruction with autologous tissue has increased progressively. This type of reconstruction is generally recommended for patients who have adequate soft tissue excess at the donor site and do not want to use alloplastic materials for breast reconstruction.

25.3.1 Types of Autologous Reconstruction

Broadly speaking, autologous breast reconstruction can be performed using pedicled flaps or free flaps. Pedicled flaps originate from tissue close to the breast (the thoracodorsal region and abdomen) that is transferred from its natural location to the chest, maintaining the blood supply through its native vascular pedicle. In general, these types of flaps are technically less demanding, with shorter operative times and a lower risk of partial or total flap failure. However, potential loss of donor site function can result when the muscle is included in the pedicle flap.

Alternatively, free flaps can be taken from areas close to or far from the breast. They are disconnected from their native blood supply and reconnected in the chest to the internal mammary or thoracodorsal vessels using microsurgical techniques. The major advance in autologous breast reconstruction has been the development of perforator flaps. These allow the harvesting of more tissue, without sacrificing the underlying muscle and minimizing donor site morbidity. However, the procedure is technically more demanding, with longer operating times, prolonged hospital stays, and the relative risk of partial or total flap failure.

25.3.2 Donor Sites

Excellent results can be obtained with a variety of flaps, from various donor sites (see below). The most commonly used flaps for breast reconstruction are from the abdominal region. These include the transverse rectus abdominis myocutaneous (TRAM) flap, the deep inferior epigastric artery perforator (DIEAP) flap, and the superficial inferior epigastric artery (SIEA) flap. Other widely used flaps are those of the dorsal region, including the latissimus dorsi myocutaneous (LDM) flap, and the thoracodorsal artery perforator (TDAP) flap.

Donor sites that have gained popularity as an alternative to abdominal flaps include the gluteal region with the superior gluteal artery perforator (SGAP) flap, the lumbar region that provides the lumbar artery perforator (LAP) flap, and the thighs that include the transverse or diagonal upper gracilis (TUG, DUG) flaps and the profunda artery perforator (PAP) flap.

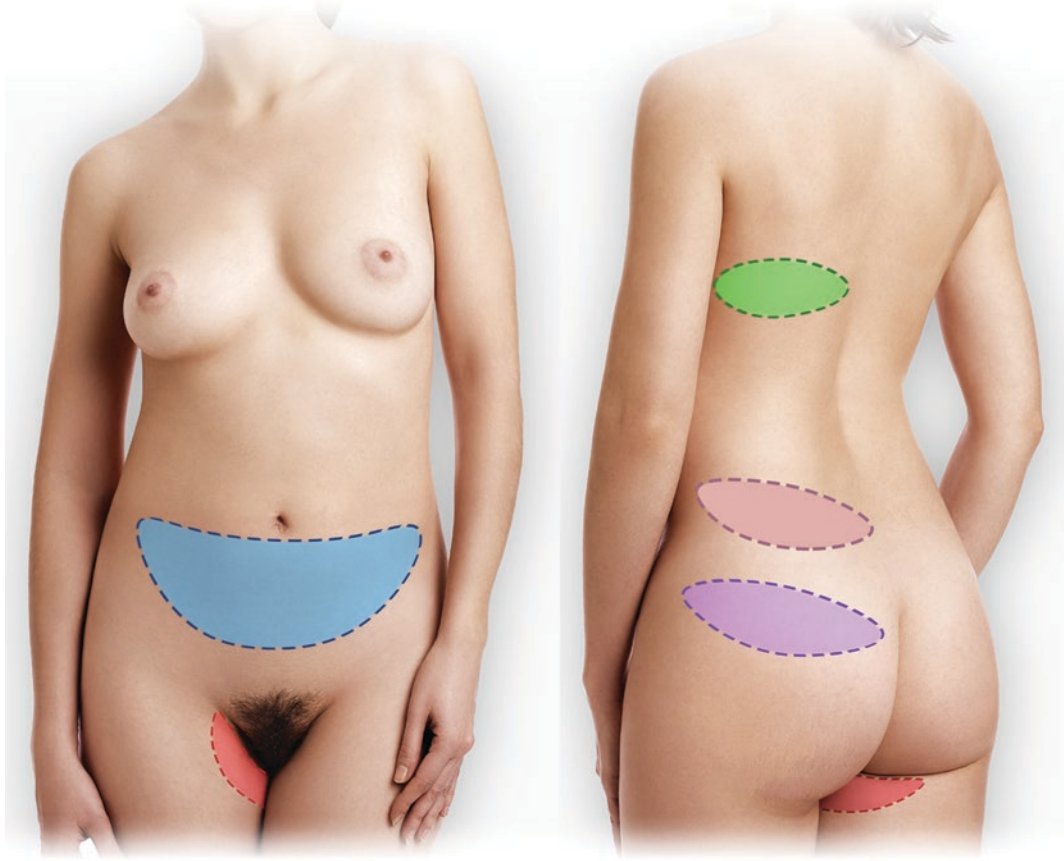

Fig. 25.3 Donor sites for autologous breast reconstruction

Key Point
The selection of the flap will basically depend on the suitability of the donor site, the surgeon's experience, and the patient's preferences (Fig. 25.3).

25.3.2.1 LDM Flap

The use of a pedicled myocutaneous flap from the dorsal region to cover the defects of breast amputation was first published by Iginio Tasini in 1906 [19]. Nevertheless, this technique was excluded for decades until Neven Olivari, in the mid-1970s, once again described the latissimus dorsi flap to cover defects of the anterior thoracic wall and irradiation damage following mastectomy [20], and it became the workhorse flap for autologous breast reconstruction in the following decades.

The technique consists of removing a significant amount of skin and subcutaneous tissue from the thoracodorsal region and part of the latissimus dorsi muscle. The flap is then transferred to the chest through an axillary tunnel. The LDM flap is based on the thoracodorsal vessels that provide a reliable blood supply and do not present significant anatomical variations that prevent its safe anterior transposition [21].

The LDM flap is technically simple to harvest and does not require microsurgery. The skin paddle size should not exceed 10–15 cm width in order to achieve primary closure, and the donor site scar can be hidden under the brassiere. However, the appearance and consistency of the thoracodorsal tissue may differ from that of a normal breast.

An important disadvantage of this flap is the possible limited amount of tissue available to recreate a breast. In addition, the muscle may undergo atrophy. It is therefore generally neces-

sary to combine this technique with the use of breast implants. Regarding muscle transposition, dynamic weakness may occur in the extension and adduction of the shoulder and may hinder the performance of certain sports and even daily activities [22].

Key Point
The result that can be achieved with the LDM flap is frequently satisfactory, but it is currently one of the last options for breast reconstruction.

25.3.2.2 TRAM Flap

The first breast reconstructions with abdominal tissue were performed by Sir Harold Gillies in the 1940s [23]. These procedures consisted of the staged transfer of a tubed abdominal flap, incorporating the umbilicus for the "nipple." Later, in 1977, Drever reported the transfer of a vertically oriented skin-muscle flap of the rectus abdominis, based on the deep superior epigastric vessels, tunneled to the mammary region [24]. In 1979, Robbins described a similar vertically oriented abdominal flap for breast reconstruction [25]. Soon after this, in 1982, Hartrampf et al. [26] reported and popularized the use of a transversely oriented rectus abdominis myocutaneous pedicle flap.

The TRAM flap has a reliable and extensive vascular pedicle which allows a wide arc of rotation to be tunneled through the thoracic-abdominal region and be inserted in the ipsilateral or contralateral mammary region. It even allows the safe transfer of a large amount of tissue with characteristics that are very similar to those of a natural breast, without the need for microsurgery, and within a relatively short operating time.

The most significant comorbidity of this technique is the resulting abdominal-wall weakness. Although there is an aesthetic improvement in the abdominal area, a localized bulge is often observed in the para-infra-umbilical region, corresponding to the muscle defect [27]. Nonetheless, the incidence of abdominal bulges and hernia can be significantly decreased by repair of the anterior rectus with the placement of a polypropylene mesh [28]. Breast reconstruction with a pedicled TRAM flap is therefore not indicated in obese patients or in those considering pregnancy.

Key Point
The TRAM flap is also one of the last options for breast reconstruction due to its considerable comorbidity at the donor site. However, it is still the chosen technique in many parts of the world.

25.3.2.3 DIEAP Flap

In 1979, for the first time, Holmstrom reported the transfer of a free transverse-oriented myocutaneous flap from the abdominal region based on the deep inferior epigastric vessels [29]. Nevertheless, the great advance in autologous breast reconstruction with abdominal tissue occurred with the development of perforator flaps. In 1989, Koshima and Soeda [30] published the use of abdominal flaps based on perforators of the deep inferior epigastric vessels without the rectus abdominal muscle. In 1994, Allen and Treece [31] described its application for breast reconstruction, and together with Blondeel [32], they expanded the use of this technique to a high technical level, after which it quickly gained great popularity worldwide.

The DIEAP flap provides a large amount of well-vascularized skin and subcutaneous tissue and a pedicle of good length and caliber. It offers a natural and permanent result with minimal morbidity at the donor site because the rectus abdominus muscle is not sacrificed; the incidence of hernias and abdominal bulging therefore decreases considerably [33]. This technique also improves the body contour of the abdomen, leaving a well-hidden scar. Compared with the TRAM flap, postoperative pain is minimal, the recovery period is shorter, and the patient returns to normal life more rapidly.

Nevertheless, a few aspects of this technique can be considered disadvantages. Like other perforator flaps, the intervention requires a longer learning curve and considerable experience in microsurgical techniques. Preoperative assessment with computed tomography (CT) angiography is essential go locate the dominant

perforator preoperatively and perform safe surgery. The intervention takes longer than that for the TRAM flap, and the risk for immediate microvascular complications is higher [34].

Key Point
Nowadays, the DIEAP flap is considered the first choice for breast reconstruction with autologous tissue. This flap is especially indicated for unilateral or bilateral breast reconstruction in patients who have excess abdominal tissue and who have not had previous abdominal surgeries in which perforators could have been sacrificed (Fig. 25.4).

25.3.2.4 SIEA Flap

The first description of the use of a pedicled abdominal flap based on superficial epigastric vessels was published by Wood in 1863 [35]. More than a century later, in 1971, it was described as a free flap by Antia and Buch [36]. For breast reconstruction, however, the application of the SIEA free flap was first described by Allen, in 1989 [37], and the first case report published was that by Grotting, in 1991 [38].

The vessels of the superficial epigastric system lie just below the skin and are easily located preoperatively using a Doppler ultrasound. The additional advantage over the DIEAP flap is that the SIEA flap is raised in a suprafascial plane, allowing less complex and relatively faster dis-

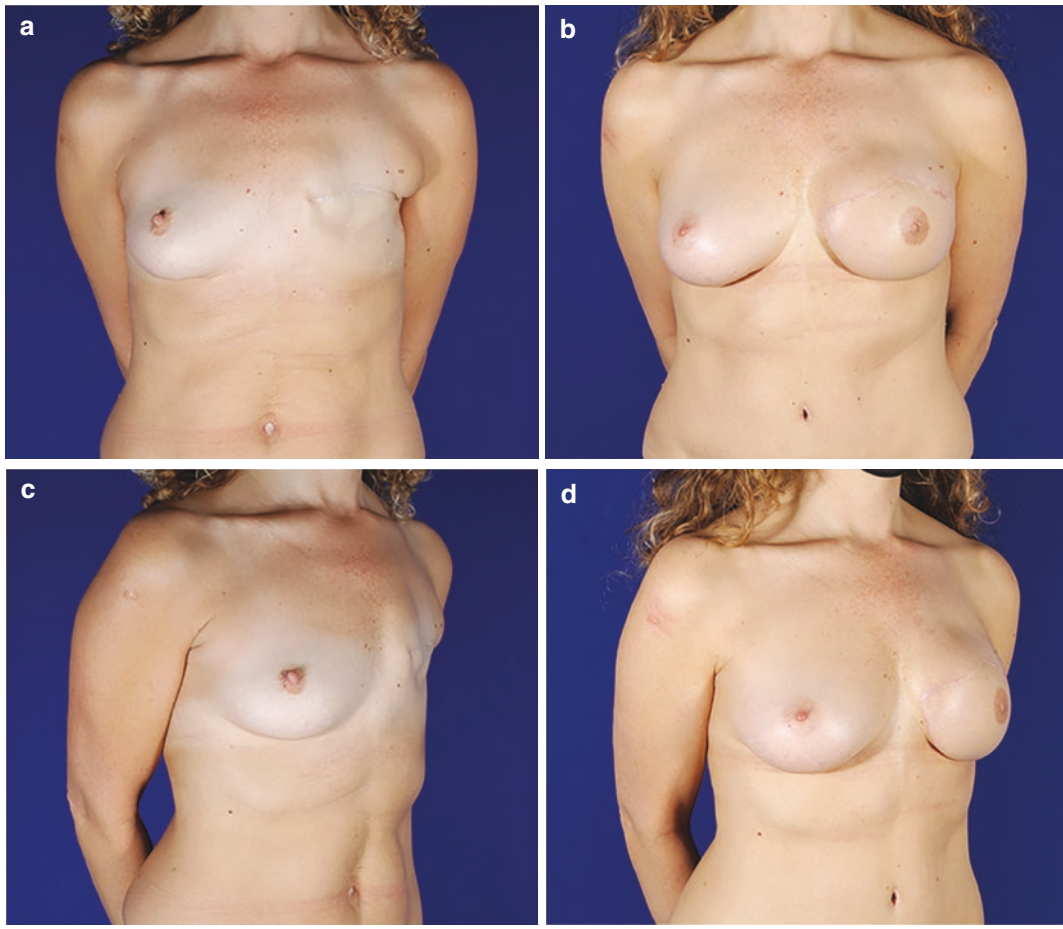

Fig. 25.4 Left breast reconstruction with DIEAP flap and contralateral augmentation mammoplasty. Preoperative (**a**, **c**) and postoperative (**b**, **d**) images

section. Besides, as there is no need to perform a fasciotomy and myotomy, the integrity of the abdominal wall is not altered, thus, morbidity at the donor site is minimal [39].

Nonetheless, the SIEA is anatomically inconstant. It may not therefore be available for use in all possible candidates. Besides, its short pedicle and small arterial caliber make anastomosis with the recipient-site vessels technically more demanding. Another disadvantage is that the cutaneous territory irrigated by the SIEA is mainly limited to the ipsilateral hemiabdomen, so if all the lower abdominal tissue is needed to perform a unilateral breast reconstruction, an extra anastomosis will be necessary to ensure the vascularization of the entire flap.

To perform safe surgery with this flap, intraoperative comparison of vascular dominance of the superficial inferior epigastric system and the deep inferior epigastric system is essential. When perfusion of the superficial system is not adequate, it is advisable to perform a DIEAP flap. Special attention is necessary to identify abdominal scars that may contraindicate the use of this flap, such as the lower transverse abdominal scar (Pfannestiel).

Key Point
The indications for SIEA flap breast reconstruction are practically the same as those for the DIEAP flap, and it is a good option for women with small breasts who undergo bilateral breast reconstruction (Fig. 25.5).

25.3.2.5 SGAP Flap

As early as 1920, Sir Harold Gillies advocated a tube pedicle to transfer a slice of skin and fat from the buttock to create a breast [23]. In 1973, Orticochea published the first report on the transplantation of a myocutaneous flap from the gluteal region, in multiple stages, using the volar aspect of the forearm as a transport medium to reconstruct the breast [40]. Shortly afterward, in 1975, Fujino et al. reported the use of a free myocutaneous flap based on the superior gluteal artery for breast reconstruction [41]. With the advent of perforator flaps, Koshima et al. described the gluteal flap based on perforators of the superior gluteal artery in 1993 [42], and its application for breast reconstruction was reported in 1995 by Allen and Tucker [43].

The adipocutaneous tissue of the upper gluteal area is a suitable option for breast reconstruction due to its consistency, volume, and reliable anatomy. However, harvesting the SGAP flap can be challenging because of the complexity of the intramuscular dissection of the short pedicle (5–7 cm). In this context, CT angiography can be very helpful to preoperatively identify the trajectory of the suitable perforator. Furthermore, in most cases, it is necessary to use arterial and venous grafts to increase the length and match the caliber to the recipient-site vessels. Likewise, during the dissection, special care must be taken to avoid damaging vital anatomic structures that emerge caudally to the piriformis muscle, such as the sciatic nerve, the inferior gluteal artery, the internal pudendal artery, and the posterior femoral cutaneous nerve.

Although the donor site scar can be well hidden by underwear, the contour defect produced in the upper part of the buttock can be significant, requiring secondary refinement with lipofilling at the donor site in almost all cases.

Key Point
The SGAP flap has become a valuable alternative for autologous breast reconstruction when the abdominal tissue is not adequate, especially in bilateral breast reconstructions and in patients considering pregnancy after breast reconstruction (Fig. 25.6).

25.3.2.6 LAP Flap

In 1978, Hill et al. published the anatomical basis of a transverse lumbosacral back flap and its use as a transposition flap based on the intercostal and lumbar perforators [44]. Nonetheless, the first description of the anatomical path and vascular territory of the lumbar artery perforators was published in 1999, by Kato et al. [45]. Later, in 2003, De Weerd et al. [46] reported the use of a free LAP flap for breast reconstruction.

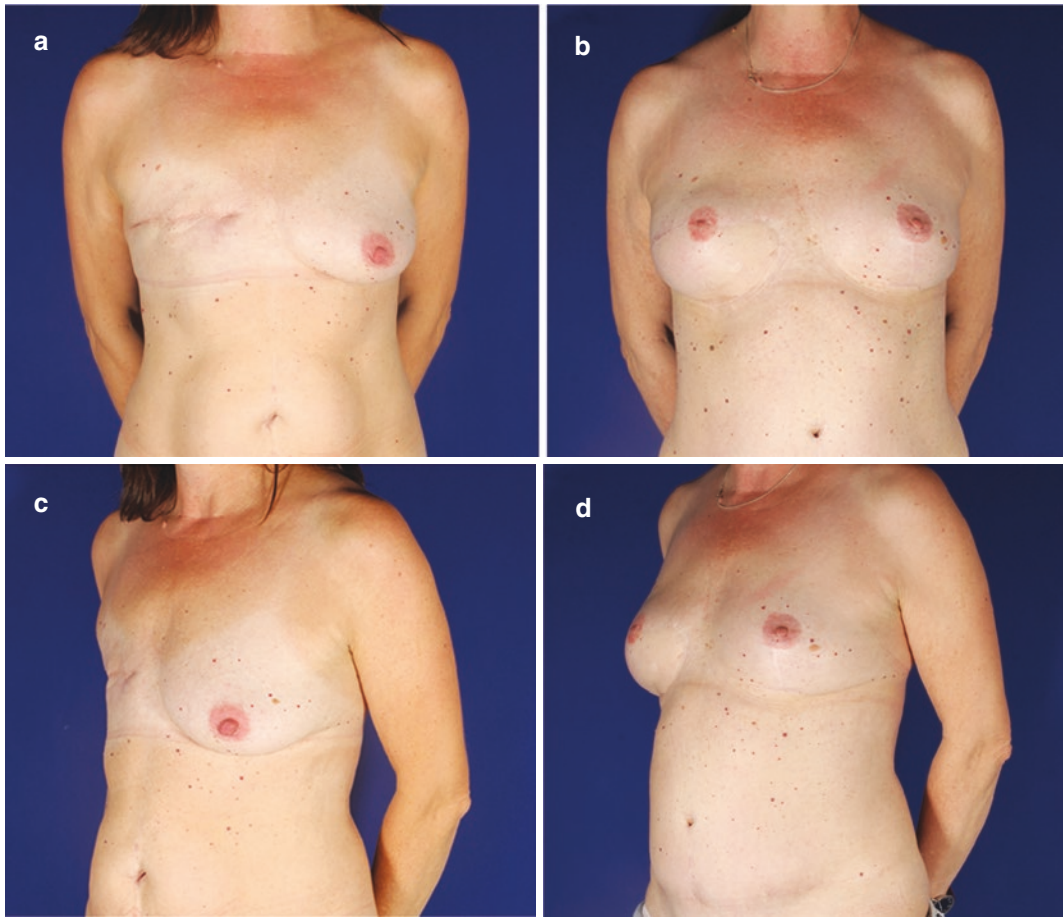

Fig. 25.5 Right breast reconstruction with SIEAP flap and contralateral mastopexy. Preoperative (**a**, **c**) and postoperative (**b**, **d**) images

The donor site area for this flap is essentially the same as that for a traditional buttock lift. The fatty tissue tends to be less sturdy than that of the SGAP flap, making shaping of the new breast easier. Nonetheless, harvesting a LAP flap can be challenging even for experienced microsurgeons in terms of perforator identification and dissection through the thoracolumbar fascia. In addition, the pedicle can be rather short (average 6–7 cm), and there tends to be a size discrepancy between the diameter of the lumbar perforators and the recipient-site vessels, making the use of an interposition arterial and venous graft necessary. To facilitate flap design and harvest, preoperative planning with CT angiography is therefore crucial to assess the location and trajectory of the perforators [47].

Regarding the resulting donor-site scar, sometimes, it may be slightly high, making it difficult to hide with underwear. Besides, a sensory deficit may occur in the upper gluteus due to the section of the cluneal nerve during flap dissection, especially when looking for a sensitive flap, but this rarely bothers the patient. Moreover, unilateral harvesting of the LAP flap may frequently require liposuction of the contralateral lumbar region to symmetrize the contour.

Key Point

The LAP flap is among the most complex flaps in the microsurgeon's armamentarium and is a reliable alternative when abdominal and gluteal areas are not available (Fig. 25.7).

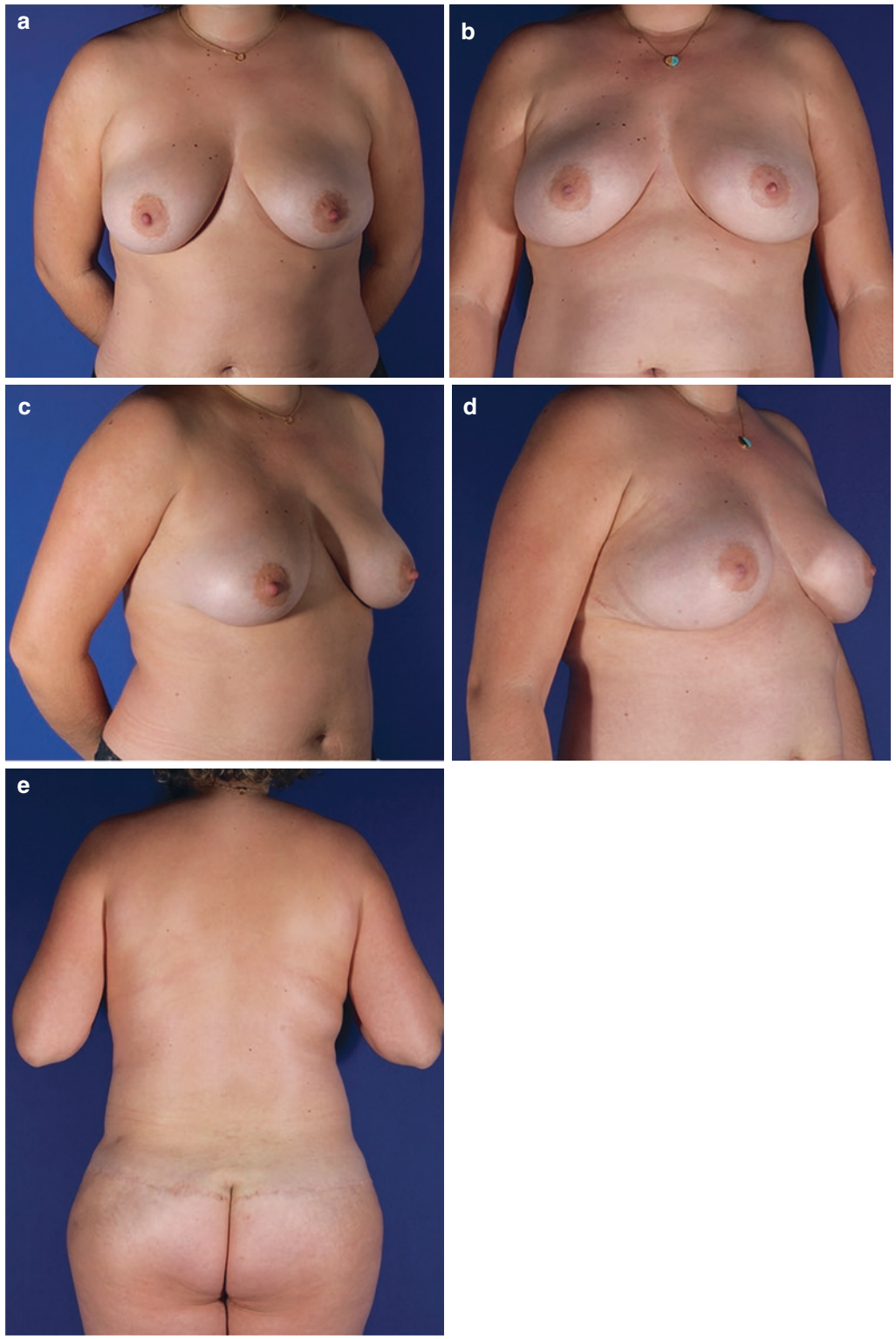

Fig. 25.6 Bilateral breast reconstruction with SGAP flaps following subcutaneous mastectomies. Preoperative (**a**, **c**) and postoperative (**b**, **d**, **e**) images

Fig. 25.7 Right breast reconstruction with LAP flap. Preoperative (**a**, **c**) and postoperative (**b**, **d**) images

25.3.2.7 TDAP Flap

The thoracodorsal artery perforator flap is an evolution of the LDM flap. It was developed in the search to individualize the thoracodorsal pedicle and incorporate the smallest amount of muscle in order to reduce morbidity at the donor site. The TDAP flap was first described by Angrigiani et al. in 1995 [48]. Although the use of the TDAP flap as a possible method for breast reconstruction was reported in 1996 [49], the first clinical experience of its application for breast reconstruction was published by Hamdi et al. in 2004 [50]. It soon gained wide acceptance due to its versatility, reliability, and low donor site morbidity.

Although identifying a reliable thoracodorsal perforator could be challenging and the pedicle dissection is time-consuming, the main advantage of the TDAP flap when compared with the LDM flap is the preservation of muscle function and motor nerves of the lateral thoracic area.

Key Point

The TDAP flap is an excellent option for breast reconstruction in patients with small breasts when abdominal tissue is not available (Fig. 25.8). It can be combined with fat grafting into the flap or with the placement of an implant in order to achieve the same size as the contralateral breast. The TDAP flap is also indicated for partial breast reconstruction after a lumpectomy and as a salvage flap in the case of complications from other breast reconstructions techniques (Fig. 25.9) [51].

25.3.2.8 Thigh Flaps

In recent years, the thigh regions have become an excellent alternative for autologous breast reconstruction, especially in women who do not have sufficient tissue in other possible donor sites.

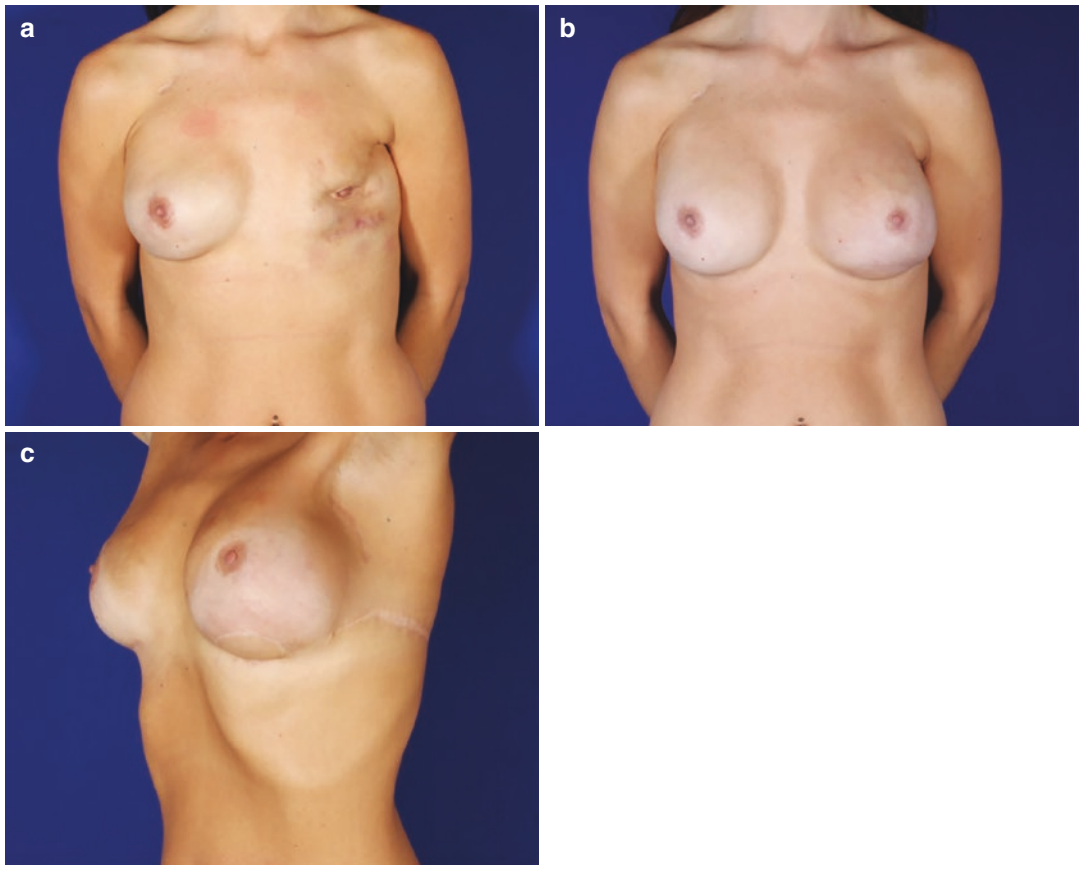

Fig. 25.8 Left breast reconstruction with TDAP flap and implant. Preoperative (**a**) and postoperative (**b**, **c**) images.

Fig. 25.9 The use of TDAP flap to cover a lateral defect after partial loss of a previous DIEAP flap breast reconstruction

Flaps such as the transverse upper gracilis (TUG) flap and the diagonal upper gracilis (DUG) flap are good options when there is excess tissue in the medial part of the thigh [52, 53]. In contrast, the profunda artery perforator (PAP) flap is a reliable alternative when there is small-to-moderate lipodystrophy in the posterior thigh region [54].

The medial thigh-based flaps have a reliable dominant vascular pedicle, the donor site can usually be closed primarily, and morbidity is minimal. Special care should be taken not to overextend the flap to the anterior part of the thigh in order to avoid damaging the inguinal lymph nodes and causing disruption of the lymphatic drainage of the leg. Nevertheless, the donor site can often result in an unfavorable change in the contour of the thigh and the scar is not well hidden by underwear.

The vascular pedicle of the PAP flap is long compared to the medial thigh-based flaps, and dissection is distant from the lymphatics, reducing the risk of seroma. Wound dehiscence is a potential donor site complication, so the flap should not exceed 7 cm in width to ensure primary closure. Unlike the SGAP flap, the gluteal contour is not affected, and the donor-site scar is well hidden in the sub-gluteal crease, being less visible than the more anterior scar of the medial thigh-based flaps.

Key Point
The thigh-based flaps provide soft and pliable tissue that is suitable for breast reconstruction in patient with small breasts. Besides, they also add the option of bilateral harvesting and simultaneous breast reconstructions.

25.4 Secondary Refinements for the Reconstructed Breast

In general, breast reconstruction with the different techniques offers satisfying aesthetic results. However, in many cases, refinement procedures might be needed to achieve a more natural appearance and better symmetry between breasts (Fig. 25.7b).

Key Point
Contour irregularities, volume discrepancy, asymmetrical infra-mammary fold position, and reconstruction of the nipple-areola complex are the most common indications for secondary procedures for the reconstructed breast.

In cases of unilateral reconstructions, the healthy breast will rarely need revision because mastopexy with augmentation or reduction mammoplasty should always be addressed in the initial surgical intervention.

Secondary procedures should be performed once the healing process after the first stage of breast reconstruction is complete. The optimal time is between 4 and 6 months. When a complementary radiotherapy is performed, secondary procedures can be postponed even longer, until the treatment is completed. However, the timing must be determined specifically in each case.

Fat grafting is probably the most important technique for the refinement of the reconstructed breast. It provides a significant improvement in breast contour and skin quality. In the case of breast reconstruction with autologous tissue, other refinement techniques include liposuction and direct tissue

resection. Each procedure has its specific purpose to shape the reconstructed breast, and a combination of approaches can be safely performed.

Similarly, a well-positioned inframammary fold is a crucial factor in the final appearance of the reconstructed breast. Consequently, during a secondary refinement, it may be necessary to raise or lower this fold to symmetrize it with the contralateral side.

Reconstruction of the nipple-areola complex is usually the final stage of breast reconstruction. This procedure should be performed when the patient is satisfied with the final shape, size, and symmetry of breasts. When the reconstructed breast shape will not change significantly with refinement procedures, the reconstruction of the nipple can be performed in the same procedure. Otherwise, if the refinement of the reconstructed breast will significantly change the size or shape, it is advisable to postpone nipple reconstruction to avoid the risk of wrong positioning.

The challenge of nipple reconstruction is to create a three-dimensional structure from a two-dimensional surface [55]. A number of techniques described for nipple reconstruction are associated with high patient satisfaction, including various local flaps (C.V, star flap, and skate flaps) and nipple-sharing techniques [56]. Regarding areola reconstruction, the most common techniques include skin grafts, tattoos or a combination of these (Figs. 25.4b, d and 25.5b, d).

Most nipple-areola complex reconstructions can be performed in an office setting using local anesthesia. Areolar tattooing is usually done within 3–5 months after nipple reconstruction. In women with implant-based breast reconstruction who have received postmastectomy radiotherapy, surgical reconstruction of the nipple is not advised. In such cases, 3D nipple-areola tattooing is an excellent option [57].

Take-Home Message

Breast reconstruction is an integral part of breast cancer treatment. Currently, as many effective options are available for breast reconstruction, practically, all breast cancer patients are candidates. Therefore, there are no reasons not to replace the resected breast and restore the patient's quality of life after breast cancer. Due to the variable needs of individual patients, the reconstructive surgeon must be able to provide the full range of reconstructive options and resolve any sequelae of mastectomy or previous breast reconstructions. However, effective doctor-patient communication is essential, both to provide all the necessary information and psychological support and to understand patients' expectations so as to achieve the desired result.

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