Considerations and Complications of Breast Reconstruction in the Elderly Population

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131.1 Introduction

As the treatment of breast cancer has advanced, reconstructive breast surgery has become an important aspect of comprehensive breast cancer care. Women of advanced age, specifically those over the age of 60 years, require special considerations when planning breast reconstruction. These special considerations stem not only from physical changes associated with the aging process, but also in the management of breast malignancies in this population. Although available reconstruction techniques are generally well tolerated and similar to those for younger women, there are differing rates of complications that affect this age group that both the oncologic and reconstructive surgeon must recognize. This chapter offers a discussion of these considerations and complications for surgeons involved in the management of breast disease.

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131.2 Special Considerations in the Elderly Population

131.2.1 Wound Healing Differences in the Elderly

The scientific literature has noted for almost a century that older individuals display different and notably slower rates of wound healing than their younger counterpart [1]. While it is beyond the scope of this text to give a comprehensive review on wound healing, a general overview of special wound healing considerations in the elderly is necessary.

Aging skin displays several characteristics that predispose the elderly to extended wound healing time. Although these changes are intrinsic to aging skin and may be seen in all older individuals, many aging individuals have multiple well-described extrinsic risk factors to skin aging such as UV radiation and smoking. These intrinsic and extrinsic aging factors lead to the histologic changes seen in aging skin and their clinical correlates in aging skin and wound healing [2–4].

Alteration in all components of skin is the cardinal manifestation of aged skin. A general thinning of both the dermis and epidermis as well as

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Major stages of wound healing			
	Inflammation	Proliferation	Remodeling
Day in wound healing	1–3	3–14	14 days to 2 years
Major cells	Neutrophils, Macrophages, Lymphoctes	Fibroblasts	Fibroblasts
Cytokines, growth factors	PDGF, TNF-α, TNF-β, IL-1, IL-2	FGF, EGF, VEGF	Matrix Metallo protel nases
Steps of wound healing	Coagulation and Hemostasis	Angiogenesis	Replacement of type III collagen by type I collagen
	Coagulation and Hemostasis	Granulation tissue formation	Cross linking of new collagen fibrils
	Subsequent removal of clot by phagocytic cells	Wound contracture	Regression of capillaries from scar
	Removal of bacteria and foreign material	Generation of collagen and ECM	Further wound contracture
	Secretion of chemosttractants and growth factors	Epithelial ingrowth from wound edges	Completion of epithelialization

Fig. 131.1 Stages of wound healing and the cells, cytokines, growth factors, and steps associated with each stage

flattening of the dermo-epidermal junction can give the skin a thin, weak character. There is also a marked decrease in other skin cellular components such as macrophages, fibroblasts, and Langerhans cells. Likewise, there is a reduction in extracellular matrix components such as collagen, elastin, and glycosaminoglycans. Microcirculation is also impaired in the aging skin, with an overall reduction in capillary number and an increase in capillary disorganization. Lastly, there is a decline in the number of dermal appendages with age, including sebaceous glands, sweat glands, and apocrine glands.

Each of these skin components is also affected by some degree of functional decline. Epidermal keratinocytes display a decrease in mitotic activity, a decreased propensity to migrate, and an increase in the duration of the cell cycle. While collagen and elastin show a decline in overall amount, their fibrils also become more disorganized leading to decreased function. Even the dermal appendages do not function as well in the elderly, producing less sweat and lipids necessary for maintenance of skin moisture. Notably, there has been extensive research into the dysfunction of macrophages and lymphocyte cytokines in the aging population. Not only have these cells, regarded as the most important in the wound healing process, been shown to be impaired in the aging population, but murine models of wound healing have also shown different expressions of circulating cytokines in the elderly [5–7].

The reconstructive surgeon can extrapolate this information to determine how these changes may disturb the three major stages of wound healing: Inflammation, Proliferation, and Remodeling (Fig. 131.1) [8]. Impaired macrophage and Langerhans cell function can delay or prevent the inflammatory phase of wound healing. With poor circulation and limited delivery of critical cellular and non-cellular mediators of the wound healing cascade, wound healing may fail to initiate. Clinically, these changes manifest as problems very familiar to the plastic and reconstructive surgeon, such as the chronic ulceration seen in many lower extremity wounds. Older individuals may also experience skin sloughing, superficial skin necrosis, osteomyelitis, soft tissue infection, or other clinical problems [9–11].

The Proliferation phase of wound healing can be the most affected stage in older individuals. The formation of granulation tissue is an important part of this stage of wound healing. Altered angiogenesis, decreased fibroblast number and proliferation, and an excess of matrix metalloproteinases manifests as delayed granulation tissue formation and wound healing. Likewise, problems with keratinocyte proliferation and migration have lead many clinicians to note a tendency for delayed re-epithelialization of an adequate wound bed [12]. These processes overall tend to constitute a delay in the wound healing process. Healthy older individuals will still completely heal their wounds as younger individuals, but only at a slightly reduced rate [13].

131.2.2 Body Mass Index (BMI) Differences in the Elderly

Breast reconstruction in the aging population is significantly affected by the increased body mass index (BMI) of the elderly. While it has been noted that most individuals have an increase in BMI with age, recent obesity trends in the Western world have shown an alarming increase in BMI overall [14–16]. This trend has significant impact on older women seeking breast reconstruction.

Obesity is accompanied by a specialized collection of comorbidities in addition to those

already known to affect an older patient population. Hypercholesterolemia, hypertension, increased insulin resistance, an increase in cardiovascular risk, and peripheral vascular disease are well-known sequelae of obesity and metabolic syndrome [17]. These systemic effects of obesity create a well-established rise in surgical morbidity and mortality among those patients with a higher BMI. Breast reconstruction surgery has not been immune to these effects, as increased BMI has been shown to increase the risk of infection, prolonged hospital stay, and graft or prosthesis loss [18]. Furthermore, obesity has been shown to increase re-operation rates and medical complications, including venous thromboembolism (VTE). For instance, class I (BMI 30–34.9 kg/m^2), class II (BMI 35–39.9 kg/m^2), and class III (BMI >40.0 kg/m^2) obesity have been shown to be independent risk factors for VTE or pulmonary embolus (PE) at odds ratios (OR) of 2.20, 1.60, and 2.88 respectively. Obesity has similarly been linked to be an independent risk factor for readmission following plastic surgery procedures at an odds ratio of 1.2 compared to the general population [19, 20].

Of note, many studies have shown obesity to be a significant risk factor for implant-based reconstruction and autologous reconstruction, with autologous reconstruction showing a lower rate of reconstructive loss in comparison [21–24]. Despite this rise in surgical morbidity, both implant based and autologous breast reconstruction in the obese population is generally well tolerated.

A recent meta-analysis by Schaverien et al. [25] that included over 3,700 patients undergoing autologous free tissue transfer breast reconstruction, obese patients were indeed found to have a higher overall complication rate, with an odds ratio of 2.77 when compared to their non-obese counterparts. However, significant complications only occurred at an alarming rate in those with class III obesity as defined above, leading the authors to conclude that autologous free tissue transfer was generally safe but should be avoided in patients with a BMI greater than 40 kg/m^2. Similarly, Chang et al. [26] evaluated 936 free transverse rectus abdominis myocutaneous (fTRAM) breast reconstructions in 718 patients and found obese patients to be at increased risk when compared to their non-obese counterparts for overall flap complications (39.1 % vs 20.4 %) and overall donor site complications (19.8 % vs 11.1 %). These included flap loss (1.9 % vs 0 %), mastectomy flap necrosis (15.1 % vs 6.6 %), abdominal bulge (5.2 % vs 1.8 %), and hernia (4.3 % vs 1.6 %). The authors concluded that the vast majority of obese patients undergo successful reconstructions and that surgery should still be offered to this patient population as long as the surgeon and the patient are aware of the increased propensity for complication.

Obese patients are at increased risk for implant complications. McCarthy et al. [24] described 1,170 expander/implant based reconstructions in 884 women. They found that obese patients to be almost twice as likely to experience a complication from implant based reconstruction as non-obese patients (OR 1.8). The same study found those over the age of 60 over twice as likely to have a complication (OR 2.5). Completing their analysis, though, the authors concluded that obesity was a risk factor for reconstructive failure using an implant (OR 6.9) while age was not a significant risk factor for implant failure (OR 3.3). A more recent study by Fischer et al. [21] corroborates those findings. They found that patients with class II or class III obesity were at greater risk for early implant failure, with an odds ratio of 3.17 and 2.41 when compared to non-obese patients. It is also worth mentioning here that this group determined that age greater than 55 was an independent risk factor for implant based reconstruction failure (OR 1.66).

Due to the increased risk of surgical morbidity associated with obesity, careful patient selection is paramount. When planning breast reconstruction in this patient population, special consideration should be given not only to patient preference, but also to operative time, hospital stay, and total number of planned reconstructive procedures.

131.2.3 Incidence of Medical Comorbidities in the Elderly

It is well established that as age increases, incidence of morbidity and mortality increases. In fact, age has been proven to be a risk factor for

ASA class	Definition
Class I	A normally healthy patient
Class II	A patient with mild systemic disease
Class III	A patient with systemic disease that is not incapacitating
Class IV	A patient with an incapacitating systemic disease that is a constant threat to life
Class V	A moribund patient who is not expected to survive for 24 hours with or without operation

Fig. 131.2 American Society of Anesthesiologists (ASA) classification system

increased morbidity and mortality independent of the risk of other diseases [27–29]. Many surgeons view such generalizations as reasons to deny an elderly patient a procedure that may ultimately be of great benefit. As with all patient populations though, patient selection is key. It is worth noting that, based on several factors, those patients presenting for breast reconstruction are often considered low risk surgical candidates, despite their age.

The elective nature of reconstructive breast surgery lends itself to medically optimized patients. Emergency surgery portends a higher rate of complications in general, but has been shown to be especially morbid in the advanced age population [30–32]. While the oncologic portion of the breast removal process begins soon after diagnosis, it is rarely, if ever, a truly emergent situation. This allows time to assess patient comorbidities, stratify risk of surgery, and develop an appropriate operative and anesthetic plan. Other factors inherent in the nature of breast reconstruction, such as generally minimal blood loss and the lack of body cavity entry, make these procedures low risk [33, 34].

Assessment of all medical comorbidities including cardiac, pulmonary, renal, and endocrine disorders is necessary in aged patient population to decrease surgical morbidity. While each of these systems and their individual effects must be taken into account, there are useful and established grading systems for the surgeon to determine the risk of perioperative morbidity. An effective system for surgical risk stratification in the elderly population is the American Society of Anesthesiologists (ASA) physical status classifications system (Fig. 131.2) [35, 36]. While these definitions are very broad, it is helpful to know that the higher ends of the ASA status, particularly ASA IV (which takes into account some baseline functional impairment), has been identified to be an independent predictor of perioperative morbidity [30, 32]. Another useful tool in the aged population, where cardiac disease is a major cause of perioperative morbidity, is the Goldman cardiac risk assessment profile [37]. This system allows the consulting surgeon to place a relative value on risk based on physiologic and historical information. While no surgical risk assessment system is without limitations, tools such as these allow for global assessment of each patient and their relative risk to undergo surgery.

Using sound clinical judgment and the help of risk assessment tools, surgeons can select patients who are at sufficiently low risk to undergo an operation, even in elderly population. Overall, the decision to undergo surgery depends on both the willingness of each woman to undergo surgery and the willingness of the surgeon to provide her with a specific procedure. As described in subsequent sections, breast reconstruction constitutes a wide variety of procedures, each with their own particular risks and benefits. The authors encourage all surgeons who offer breast reconstruction to aged individuals to use preoperative assessment tools in conjunction with their surgical planning to offer the optimal procedure for each individual woman.

131.2.4 Differences in Treatment of Cancer in the Elderly

Breast cancer remains prevalent in the United States, with each woman having a 1 in 8 chance that she will develop breast cancer in her lifetime. Despite this, survivorship trends have improved with the overall breast cancer death rates down 34 % since 1990 [38]. Improved survival is no doubt due to the advancement of both medical and surgical techniques for disease control. There are some trends in breast cancer treatment that will affect women of advanced age in particular, and taking these factors into consideration when planning for breast reconstruction is of the utmost importance.

In treating older women, it is important to understand the biology of the disease, and the impact comorbidities have on survival [39]. Generally, breast cancer in the elderly is less aggressive than in younger patients. The breast cancers tend to be low grade, node negative, and estrogen receptor positive. Life expectancy in older patients can still be substantial- 16 years for a 70 year old and greater than 6 years for a healthy 80 year old [40]. In contrast, a shorter life expectancy leaves less time for local recurrence. Overall survival for older women with breast cancer is directly related to the presence of comorbid conditions (e.g. coronary artery disease, diabetes, and respiratory illnesses) [41]. Furthermore, patients' comorbidities may limit the choice of therapy. However as the population ages and many more people receive better health care and live healthy lives, more patients are candidates for aggressive breast cancer therapy.

The National Adjuvant Breast and Bowel Project (NSABP) B-06 trial randomized women with breast cancer to either undergo a modified radical mastectomy, lumpectomy alone, or lumpectomy with breast radiation [42]. At 20-years of follow-up, there is no difference in survival between the three groups [43]. Breast conservation should be the standard surgical approach with an elective sentinel lymph node biopsy for a clinically negative axilla [39]. When given a choice, women over 70 are more likely to choose breast-conserving surgery over a mastectomy [44].

Older women can tolerate breast irradiation as well as younger women; however, they may find 6 weeks of radiation therapy to be exhausting [45]. Furthermore, some patients may be too debilitated to undergo radiation treatments. There may be a favorable subgroup of women with T1 estrogen receptor positive, node negative cancers who can be treated with a hormonal therapy and forgo breast radiation. To test this hypothesis, the Cancer and Leukemia Group B (CALGB) initiated CALGB 9343, a randomized trial comparing the efficacy of tamoxifen alone (Tam) with tamoxifen plus RT (TamRT) in older women with ER-positive, clinical stage I breast cancer. Median follow-up for treated patients is now 12.6 years for these patients. At 10 years, 98 % of patients receiving TamRT (95 % CI, 96–99 %) compared with 90 % of those receiving Tam (95 % CI, 85–93 %) were free from local and regional recurrences. Ten-year overall survival was 67 % (95 % CI, 62–72 %) and 66 % (95 % CI, 61–71 %) in the TamRT and Tam groups, respectively. Radiation may be eliminated in this select group of older women with estrogen receptor positive breast cancers [46].

Older women with estrogen receptor positive breast cancer should be treated with endocrine therapy if they are candidates. They can be given tamoxifen or an aromatase inhibitor (AI). AIs work by suppressing endogenous estrogen to an extremely low level in postmenopausal women. The Arimidex, Tamoxifen, Alone or in Combination (ATAC) trial, a randomized trial in postmenopausal women with operable breast cancer, showed that the use of anastrozole resulted in a longer disease free survival and time to recurrence than Tamoxifen [47]. Furthermore, women who are not surgical candidates due to their comorbidities with an estrogen receptor positive breast cancer can be given either tamoxifen or an aromatase inhibitor as their sole treatment of their breast cancer [48].

131.3 Techniques for Breast Reconstruction in the Elderly

131.3.1 Patient Education on Breast Reconstructive Options and Techniques in the Elderly Population

There are many factors to consider when offering breast reconstruction to the breast cancer patient with advanced age. Whether it is the fear of women to undergo further operative procedures, or the fear of surgeons to offer these women breast reconstruction, it is clear that advanced aged women tend to seek and receive reconstruction at a diminished rate when compared to their younger counterparts. August et al. in 1994 [49] reviewed 271 breast reconstructions at their institution from 1988 to 1992 and found that 7 % of women 60 years and older underwent breast reconstruction following mastectomy while 38 % of younger women pursued this option. A similar study by Alderman et al. [50] described 1,607 women out of 10,406 who underwent breast reconstruction (about 15 % of women in total) within 4 months of mastectomy. They found that compared to women of 45–54 years old, those 55–64, 65–74, and 75 and older were progressively less likely to undergo breast reconstruction (OR 0.48, OR 0.45, and OR 0.29 respectively). Levine et al. [51] confirmed differential rates of breast reconstruction in different age groups. In their retrospective review of 309 patients undergoing breast reconstruction at their institution over a 9 year period, they found that those women over the age of 60 seek reconstruction at a much lower rate. Of 91 women in their 40s, 30 women sought mastectomy alone while 61 women received mastectomy and reconstruction. Of the 59 included women in their 60s, only 14 women elected for post-mastectomy reconstruction while 45 women did not. Of women in their seventh decade of life, only 3 out of 25 women elected to have reconstruction.

This trend is likely not only due to the woman's fear of undergoing surgery in advanced age, but also of the surgeon's fear of a suboptimal result or surgical morbidity. Indeed, in a study of 75 women between the ages of 60 and 77 who underwent delayed breast reconstruction, only 16 % indicated that they had been given information regarding breast reconstruction following their mastectomy [52]. Though these trends are alarming, we hope that by presenting information on breast reconstruction in this population, we can alleviate many of the fears of clinicians who would otherwise not offer these women reconstruction as well as women who would not otherwise seek reconstruction.

131.3.2 Implant-Based Reconstruction

Details regarding implant-based breast reconstruction are presented in other chapters of this textbook and will therefore not be focused on here. Briefly, this technique most commonly involves at least two separate procedures. The first operation involves the placement of a tissue expander underneath the musculature of the anterior chest with or without the use of acellular dermal matrices (ADM). This tissue expander is then accessed and inflated with saline every 1–2 weeks following the initial surgery until the desired breast contour and volume is achieved. This tissue expander is removed at a later surgery and replaced with a permanent breast implant (Fig. 131.3).

Several considerations should be given when planning implant-based reconstruction. Of utmost concern is the need for post mastectomy radiotherapy (PMRT). Radiation following expander placement is associated with a higher rate of complication, particularly capsular contracture.

Poor cosmetic result, expander extrusion, and eventual implant loss are all potential further complications. Those receiving immediate implant reconstruction and subsequent radiation also have a high rate of reoperation for either correction of defects created by radiation or replacement of the reconstruction by an autologous flap. If at all possible, expander implant reconstruction should be delayed until after any planned radiation [53–55]. In contrast, chemotherapy does not seem to increase the complication rate of implant-based breast reconstruction, therefore implant/

Fig. 131.3 Implant-based breast reconstruction. (*Top*) Pre-mastectomy female who is to undergo bilateral two stage implant-based reconstruction. (*Bottom*) Patient after completion of reconstruction

expander reconstruction may be safely performed in the immediate fashion in those patients who will receive adjuvant chemotherapy.

In order to minimize the number of operative procedures and their associated anesthesia risks, it is reasonable to consider a single stage reconstruction where a permanent implant is inserted at the time of the initial procedure. The ability to perform single stage implant-based breast reconstruction depends on multiple factors. The amount and quality of the remaining mastectomy flaps will play a large role in the ability to perform this operation safely in a single stage. To this end, the reconstructive surgeon must understand what surgical options the oncologic surgeon is willing to offer to each patient, as skin-sparing mastectomy, nipple-sparing mastectomy, and other advanced mastectomy techniques are not available at all institutions nor are they applicable to every individual [56, 57]. Likewise, the plan for adjuvant therapies, specifically any indications for PMRT, must be evaluated by the reconstructive surgeon due to the fact that radiotherapy significantly increases the risk of complications associated with prosthetic-based reconstructions.

131.3.3 Autologous Reconstruction

All of the autologous reconstructive options that are available to the younger woman are available to those women in the aged population. To list each option, its specific technique, and its specific indications would go beyond the scope of this chapter. However, the authors offer some insight into autologous breast reconstruction in the elderly population, as this reconstructive option has many advantages and disadvantages that must be considered when potentially using these techniques for women of advanced age.

Many reconstructive surgeons hesitate to offer elderly women the option of autologous breast reconstruction. Autologous reconstruction lends itself to a longer initial operation, since both pedicled and free tissue options are time consuming endeavors when compared to implant-based procedures. Because increased operative and anesthetic times are associated with more complications, autologous reconstruction is often viewed as adding additional risk to patients who are already considered be in a higher risk category. Patient selection is key in this aspect. While such a statement may be obvious, it is particularly

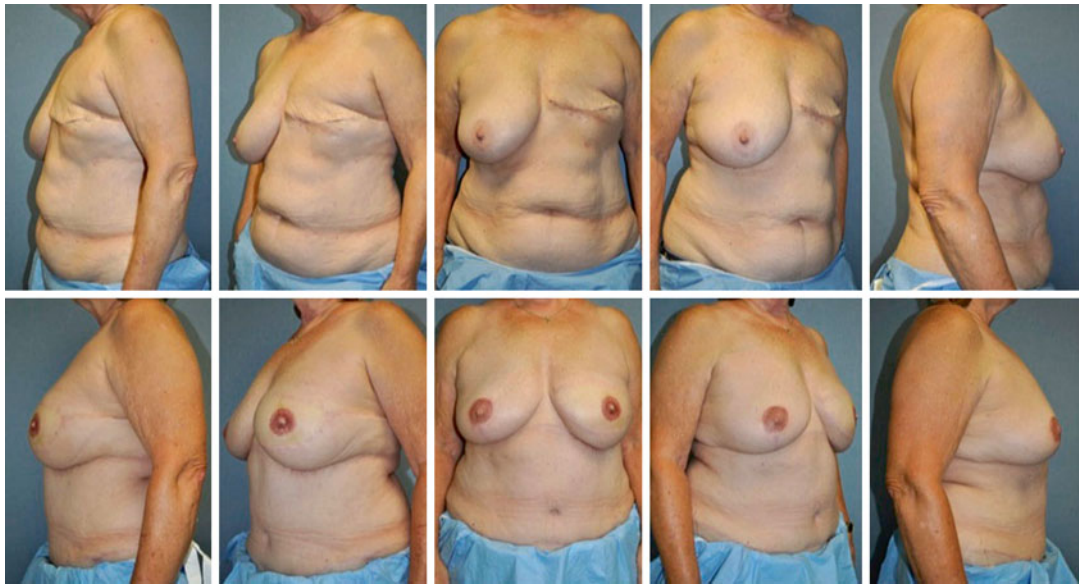

Fig. 131.4 Autologous free tissue reconstruction in a 70 year-old female. (*Top*) Preoperative image of a candidate patient with ample abdominal donor tissue. The patient is also noted to have a contralateral large, ptotic native breast. (*Bottom*) Patient after completion of reconstruction with deep inferior epigastric perforator flap and remaining reconstructive steps. Note that her abdominal scar is well hidden and there is adequate symmetry of volume and contour compared to the native breast

true in this circumstance. While the authors do agree that no woman should undergo undue risk, we also believe that aged patients should not be denied an intervention that would ultimately offer them the advantages listed below, simply due to their age. The screening tools mentioned above may be used to identify patients who are at an appropriately low risk for undergoing these procedures even in advanced age.

Many surgeons may shy away from these surgeries in the elderly population due to donor site morbidity and extended post-operative hospital stay that accompanies autologous reconstructions. Though the initial hospital admission is longer for an autologous reconstruction, secondary breast procedures are completed on an outpatient basis or even an office-based setting. In addition, there are less return clinic visits associated with autologous reconstruction when compared to an expander-based reconstruction that requires the patient to return to clinic periodically for tissue expansion. Donor site morbidity may be seen as an unnecessary side effect of autologous breast reconstruction. However, by using a woman's own tissues for their breast reconstruction, the surgeon can prevent any long-term complications associated with the introduction of a foreign body, such as a breast implant. Modern techniques utilized in autologous breast reconstruction, such as microsurgical free tissue transfer including the muscle-sparing free Transverse Rectus Abdominis Myocutaneous (MS fTRAM) and Deep Inferior Epigastric Perforator (DIEP) flaps, limit donor site morbidity and maximize aesthetic value (Fig. 131.4) [58–60].

Free tissue transfer in the elderly is an overall safe operation. In fact, multiple studies have observed that age itself is not a risk factor for complications from free tissue transfer. In these studies, a higher ASA status in the elderly individuals was related to an increased number of medical complications, but the overall rate of surgical comorbidities, such as flap loss, was generally the same as in younger populations [61–63]. For instance, Ozkan et al. [61] noted in their series of 58 free tissue transfers in 55 patients, that they did have an overall mortality rate of 5.4 %. They were quick to point out, however,

that an increase in ASA status was the correlate to increased morbidity and mortality and in particular medical complications (correlation $p = 0.0007$), rather than age itself being the predictor. In fact, in their remaining patients, the study did note an overall flap survival rate of 98.3 %. Likewise, in their study of 100 patients, Serletti et al. reported no mortalities, and only 8 of 104 flaps lost. All 8 instances of flap loss occurred in lower extremity reconstructions for advanced peripheral vascular disease, predisposing these patients to poor flap perfusion. Again, they noted a higher ASA class correlated with increased medical complications, with 64 % of those patients in ASA class III and 75 % of those in ASA class IV experiencing some type of medical complication. However, as noted above, there were no mortalities in this series [62].

These results have also held true for microsurgical breast reconstruction. Chang, et al. [63] examined 818 autologous free-tissue transfers for breast reconstruction in 650 women between July 2002 and September 2009. All patients were separated into Group 1 (age <50), Group 2 (Age 50–59), Group 3 (Age 60–69) or Group 4 (Age <70). Overall, they report only 12 instances of flap loss (1.5 %), across all age groups. Increasing age was not associated with an increased propensity for flap loss, as 10/12 lost free flaps occurred in the youngest age group. This group also noted that the incidence of medical complications did not differ among their cohorts, noting the rising rate of hypertension as the only statistically significant age dependent comorbidity. With rising rates in the elderly population. This study notes the high success rate and low complication rate of their particular population, noting no statistically significant increases in complications as the age of the cohort increased.

Overall, autologous reconstruction has many advantages to offer the aged patient undergoing breast reconstruction. While there is a risk of donor site morbidity, utilizing new microvascular procedures that minimize abdominal wall resection can offer superior results that will be tolerated well by the overwhelming majority of women. Minor complications such as fat necrosis and abdominal contour irregularities can be addressed during the subsequent stages of breast reconstruction. Despite the above, these revisions are often foregone, especially in elderly individuals. This may allow those with increased risk of surgery to have a complete reconstruction with only one exposure to anesthesia and no inherent risk of a prosthetic device.

131.4 Complications in Breast Reconstruction in the Elderly Population

131.4.1 Implant-Based Reconstruction Specific Complications

Complications related to implant-based reconstruction are an important consideration, as most women in this age group undergo implant-based reconstruction. This choice is most likely based on the perceived benefit of a shorter initial operative duration and shorter hospital stay when compared to autologous tissue reconstruction [64]. However, expander-implant based reconstructive efforts have other significant risks to consider, as the use of prosthetic material lends itself to delayed complications, such as infection, extrusion, and possible wound healing problems. Capsular contracture is another delayed complication that may necessitate removal or revision of the breast prosthesis. Furthermore, those patients that choose to undergo a two stage reconstruction with both expanders and implants will still be exposing themselves to multiple operations [65, 66].

Overall, there remains controversy in the literature regarding the safety of implant-based breast reconstruction in the aged patient population. The literature shows differing views on the risk of implant-based reconstruction. Some studies show no evidence that age increases the risk for complications from this particular type of reconstruction [67]. However, there are many that have shown that advanced age puts women at increased risk from expander and implant based reconstruction. For instance, McCarthy et al. [24] found in their study focusing strictly

on implant and expander based reconstruction, that advanced age incurred a 2.5 fold greater risk of complications from expander-implant based reconstruction.

In particular, implant based reconstruction has been shown to have a higher rate of complications than autogenous reconstruction in elderly individuals. Lipa et al. demonstrated a complication rate as high as 76 % in those women receiving implant based reconstruction, while those receiving latissimus dorsi flap reconstruction and TRAM flap reconstruction has complication rates of 41.7 % and 35 % respectively.[68] As noted by De Lorenzi et al. [69] implant reconstruction complications most frequently occurred in the delayed period, highlighting the unique risk of using prosthetic materials.

131.4.1.1 Implant Infection

Implant infection is one of the most common complications in these patients secondary to the use of foreign material in the wound, and can be a very serious complication (Fig. 131.5). The overall incidence of implant infection and wound infection is low. At our institution, for instance, only two implants had to be removed from 65 patients receiving implant based reconstruction, with rates of infection and implant extrusion being similarly low [67, 70]. However, a recent meta-analysis of over 3,000 reconstructed breasts does show surgical site infection to be greatly increased in implant based reconstruction as compared to autologous tissue reconstruction (Relative risk of infection with autologous reconstruction: 0.37) [71].

A special consideration should be mentioned here about the use of acellular dermal matrix (ADM) in expander/implant based reconstruction. While this technique is in popular use now, there is active debate over its efficacy in improving aesthetic outcomes and reducing overall complications, with various meta-analyses reporting different outcomes. Israeli noted that out of 11 studies comparing the rates of complications between implant reconstruction cases where ADMs were employed compared to those without their use, five studies note no increase in complications, while six studies noted an increase in complications [72]. Of the studies that do mention increased rates of complications, infection and implant failure are mentioned frequently. As examples, Hoppe et al. [73] and Kim et al. [74] both note an increase in both infection and reconstructive failure. Hoppe et al. included studies with 4,817 breasts in total, 977 of which received reconstruction with ADM. They note an overall twofold increase in infection and implant extrusion. Kim et al. compared 19 studies utilizing ADM (n = 2.037) with 35 studies utilizing submuscular implant placement (n = 12,837). There was an increased relative risk of both infection and reconstructive failure utilizing ADM of 2.47 and 2.80 respectively. The goal in mentioning these studies is not to deter surgeons from utilizing the ADM,

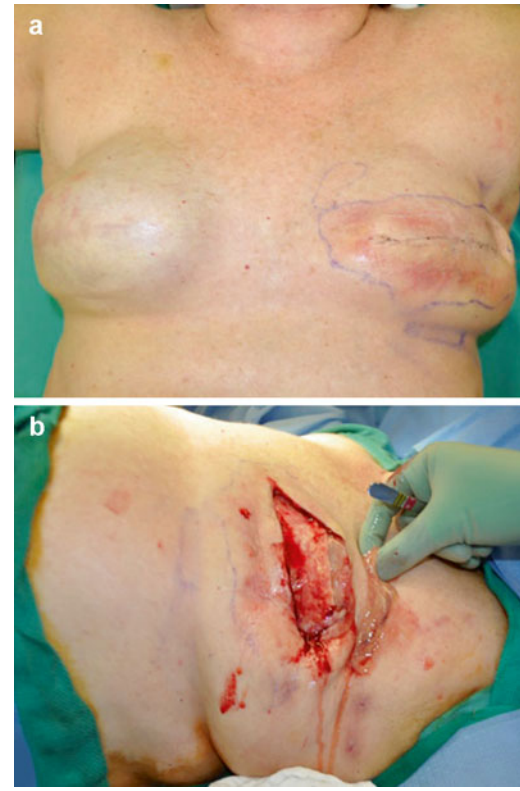

Fig. 131.5 Breast implant infection. (**a**) Breast implant infection indicated by incisional and mastectomy flap redness, edema, and pain as well as accompanying patient fever and chills. (**b**) Sero-purulent fluid drainage from the breast implant pocket, discolored inflammatory debris and unincorporated acellular dermal matrix (ADM)

but rather to make the reconstructive surgeon aware of potential complications should this option be chosen.

Another consideration of the infected implant is its risk for exposure and further infection. Implant infection and extrusion are often managed as one, with implant removal and subsequent replacement. However, there are reports of successful management of this complication with antibiotic therapy, local wound care, and occasionally local flaps for implant coverage [66, 75, 76].

131.4.1.2 Capsular Contracture

It is well known that the body will form a fibrous capsule around all implantable devices as part of a normal foreign body reaction. Pathologic capsule formation, i.e. capsular contracture, refers to a capsule which distorts the shape of the breast, becomes painful, or otherwise causes concern for the patient (Fig. 131.6). Most surgeons are familiar with this complication from breast augmentation, where the rate of capsular contracture can range from 5 to 8 % at 3 years to 11–19 % at 10 years [77]. The Baker classification system is used to describe the rate or grade of capsular contracture, utilizing Grades I-IV. Grades I and II denote a breast that looks natural, however Grade II denotes a breast that feels more firm than a natural breast. Grades III and IV are used to describe a breast that both feels and appears more firm and contracted, with Grade IV contracture signifying a painful hardening of the capsule that may trouble the affected woman even at rest. More recently, Spear and Baker [78] modified this system to specifically describe breast reconstruction patients. This new system includes the subclassifications Class IA and IB, Class IB denoting a soft but visible implant. In their system, Spear and Baker consider Classes IA, IB, II, and III acceptable outcomes for breast reconstruction, whereas painful implants (Class IV) are unacceptable.

Capsular contracture is often mentioned with breast reconstruction in regards to its prevalence with radiation. Indeed, high rates of capsular contracture have been noted in patients receiving postoperative radiation following implant-based reconstruction when compared to their non-irradiated cohorts. In their study of 107 patients treated with immediate implant-based reconstruction, Benediktsson el al [79] noted a capsular contracture rate of 41.7 % in irradiated patients vs. 14.5 % in non-irradiated patients. Behranwala et al. [55] noted similar rates of capsule formation at 14.1 % and 38.6 % in non-irradiated vs. irradiated breasts in their study of 136 breast reconstructions in 114 patients. While the mechanism of induction of capsular contracture is unknown, the literature is replete with similar studies corroborating these findings.

The best treatment for capsular contracture is also a debate, but most surgeons would advocate a capsulectomy, either partial or complete. As mentioned previously, avoiding implant-based reconstruction until after all radiation therapy is

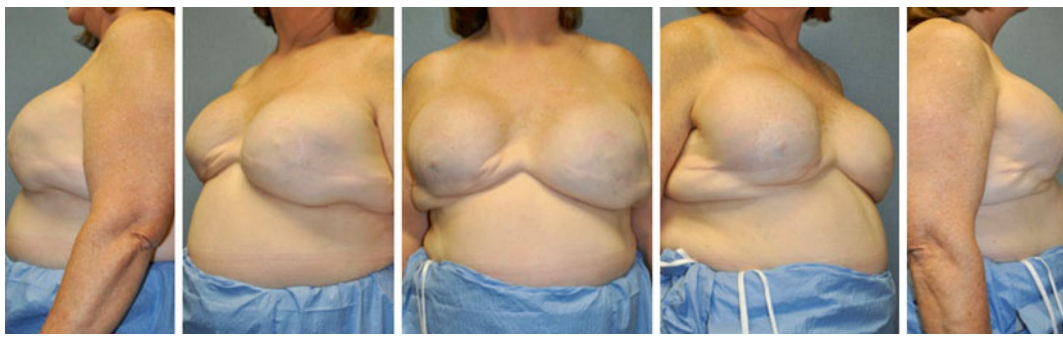

Fig. 131.6 Image demonstrating bilateral high grade capsular contracture. Patients with this deformity present with complaints of breast discomfort, asymmetry of implant position and shape, and an unnatural appearance of the breast

ideal, but is also not always achievable based on patient preference and changing clinical findings.

131.4.1.3 Implant Rupture

Implant rupture is an infrequent complication, reported to be between 0.7 and 3.5 % in studies utilizing silicone implants used for reconstruction and augmentation, with lower rates (between 0.7 and 1.7 %) noted for breast reconstruction patients [80–83]. In all cases of implant rupture, the treatment is explantation and replacement if the affected woman so desires. Diagnosis can be difficult in silicone implant rupture, as the new cohesive gels have less of a tendency to leak. However, contour deformities, pain, and focal inflammation should all be treated with suspicion when examining a patient with previous silicone implants. Ultrasound and mammography may fail to detect the implant rupture with the cohesive material, and MRI may be warranted for further evaluation [84].

Saline implants are also prone to rupture, with reported incidence from under 1 % to over 8 %. These implants tend to deflate quickly, adding ease to the diagnosis of rupture. Their rupture may also be associated with pain, however, and the gold standard for treatment is still explantation and replacement. Risk factors for saline implant deflation include under-filling the implant by greater than 25 mL (OR 3.3) and implant size greater than 450 mL [85–88].

131.4.1.4 Mastectomy Skin Flap Necrosis

While not specific to implant based reconstruction, we will briefly discuss mastectomy skin flap necrosis. The advent of skin sparing mastectomies allowed the reconstructive surgeon more tissue with which to cover the newly created breast mound. More recently, techniques for nipple-sparing mastectomy have been popularized, leading to increased use of a mastectomy technique in which the nipple areolar complex

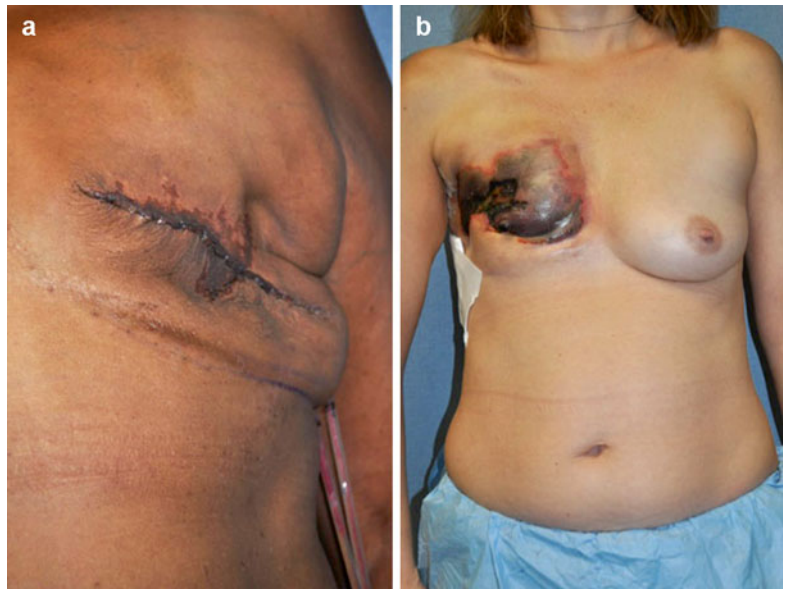

Fig. 131.7 Mastectomy flap loss. (**a**) Mastectomy Edge Necrosis. Blood supply to the distal edges of the mastectomy flaps can be caused by excessive tension placed while developing the flaps, tight closure of the skin flaps around an implant, or poor perfusion to the skin flaps from prior radiation. (**b**) Entire nipple and mastectomy flap loss. Occasionally, severe stress on the mastectomy skin flaps may manifest as complete loss of the mastectomy skin flap and possibly even the nipple. Such a complication can be problematic for further reconstruction as it increases the amount of skin needed for reconstruction

(NAC) is preserved and does not require reconstruction. As a growing body of evidence indicates the oncologic safety of the technique in select patients, nipple-sparing mastectomy is growing in popularity in facilities familiar with its use [56, 57, 89].

However, the skin flaps left behind by skin-sparing and nipple-sparing mastectomies may be affected by ischemia and subsequent necrosis (Fig. 131.7). Aggressive tissue resection, skin flap closures with excess tension, and incision design have all been implicated as potential causes of mastectomy flap ischemia/necrosis. Rusby et al. [90] notes overall rates of total and partial nipple necrosis to the 8 % and 16 % respectively. A recent literature review by Endara et al. [91] cites a nipple necrosis rate as high as 82 % in patients where a trans-areolar incision is used, with other incisions having rates closer to those previously cited, between 8.8 and 17.8 %.

Regardless of the rate, it is important that both the surgeon and the patient understand that the type of mastectomy and choice of incision may play an important role in the ultimate outcome of the breast reconstruction.

131.4.2 Autologous Tissue Reconstruction Specific Complications

A comprehensive review of the various complications of the extensive number of flaps that can be used for breast reconstruction is beyond the scope of this chapter. However, there are several complications associated with frequently employed breast reconstruction flaps that do bear mention. Listed here are the flaps and their common complications.

131.4.2.1 Latissimus Dorsi Myocutaneous Flap

The latissimus dorsi flap is one of the oldest techniques for the reconstruction of the breast mound [92]. Due to its relatively large donor site area and the large area of harvested muscle, latissimus dorsi flap reconstruction is often associated with donor site problems, the most common of which is seroma [93, 94]. Seroma has been reported to occur in as high as 79 % of all women undergoing this procedure [95]. Advanced age has been proven to be an independent risk factor for increased serous fluid drainage from the donor site, as has an increased BMI [96]. Besides leaving surgical drains in place, ancillary interventions to minimize the risk of seroma formation include the use of quilting sutures and fibrin glue in the wound bed. These measures may prevent unnecessary morbidity, including extra clinic visits for management of un-drained fluid collections or seromas that may complicate wound healing [97, 98]. The latissimus dorsi myocutaneous flap may also be used with an expander/implant for improved aesthetic results [99]. In doing so, though, the surgeon must be prepared to manage the additional possible complications of the prosthetic mentioned above.

131.4.2.2 Transverse Rectus Abdominis Myocutaneous Flap

Abdominally-based autologous flaps utilizing the rectus abdominis and its blood supply have proven to be an important part of the breast reconstruction algorithm. Though all abdominal flaps sacrifice, to some degree, the integrity of the abdominal wall, there have been significant improvements in microsurgical techniques that limit abdominal morbidity by limiting the amount of muscle sacrificed while maximizing the number of perforating vessels and blood flow to the overlying skin and subcutaneous soft tissues. The pedicled TRAM eventually evolved into the muscle sparing free TRAM (ms fTRAM), in which there were four version described. The MS-0 interrupted the rectus muscle entirely, while the MS-1 left a lateral strip of muscle intact. The MS-2 utilizes only a small central portion of muscle with its associated perforators. The MS-3 leaves no muscle attached, and is analogous to what we now know as the deep inferior epigastric artery perforator flap (DIEP) [100–104].

Despite the above described advancements, free tissue transfer breast reconstruction is not

without morbidity. Fat necrosis, abdominal wall bulge, and abdominal hernia represent the disadvantages of these operations. Fat necrosis results when a part of flap fatty tissue does not receive adequate blood supply. In general, as more muscle is taken with the microvascular flap, the less fat necrosis is seen. Presumably, this is due to an increased number of perforating vessels supplying the overlying fat. Thus, rates of fat necrosis have generally been noted to be higher in DIEP flaps than in free TRAM procedures, though this is not always reproducible nor is this fact always statistically significant [105, 106]. This fact does not mean, however, that an increased amount of harvested muscle will lead to less complications overall, as there are other significant complications to consider.

Significant morbidity of abdominal autologous reconstruction comes from abdominal wall bulge and hernia (Figs. 131.8 and 131.9). These complications are a result of the violation of the abdominal wall fascia while harvesting the necessary muscle or vessels necessary to supply the overlying fat and skin with adequate blood supply. As expected, as the harvested amount fascia and muscle increase, the rate of abdominal wall bulge and hernia also increases. Thus, pedicled TRAM flaps have a significantly higher rate of abdominal bulge than free TRAM or DIEP flaps, while the latter two procedures have similar rates of these complications with the perforator flaps having a benefit in some studies. In particular, the meta-analysis stated that the relative risk of abdominal wall bulge or hernia in DIEP flaps was around half that of the TRAM flap. Specifically, they found that abdominal bulge occurred in 3.1 % of patients who received a DIEP flap while those receiving a free TRAM flap reconstruction had a postoperative incidence of 5.9 %. Similarly, the rate of hernia was much lower in DIEP patients (0.8 %) than in TRAM flap patients (3.9 %). These rates were comparable with other studies evaluating the same outcomes [60, 104, 106, 107].

131.4.2.3 Flap Loss

A brief mention must also be made about flap loss. It is a rare complication, occurring in roughly 1 % of free TRAM procedures and 1–3 % of DIEP procedures (Fig. 131.10) [106]. Though a rare complication, it is devastating to the patient, as she now has two surgically cre-

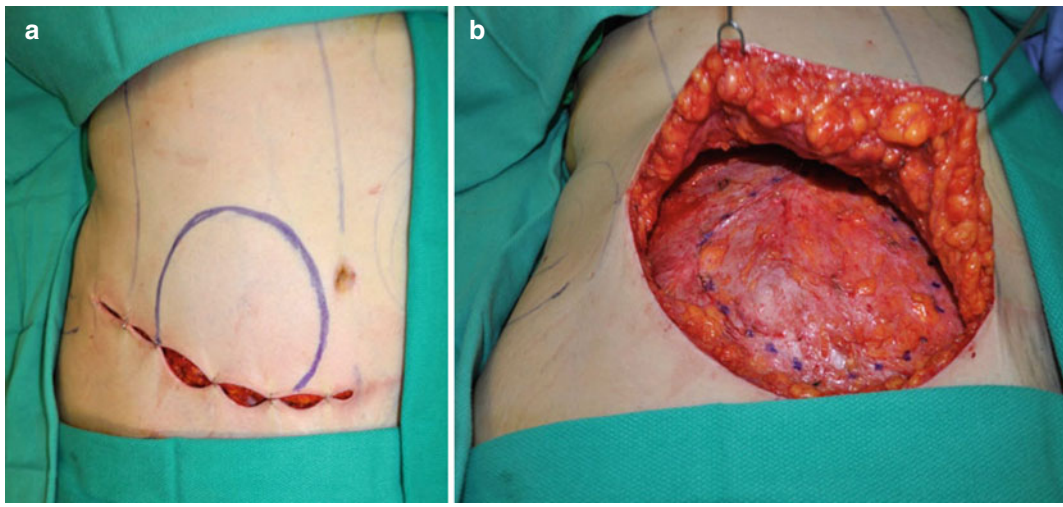

Fig. 131.8 Abdominal bulge. (**a**) Cutaneous markings and fascial bulging identified on dissection of the anterior abdominal wall. (**b**) The abdominal wall musculature reveals that the defect is made up a weakening of the abdominal musculature due to violation of the fascia for dissection of the vascular pedicle

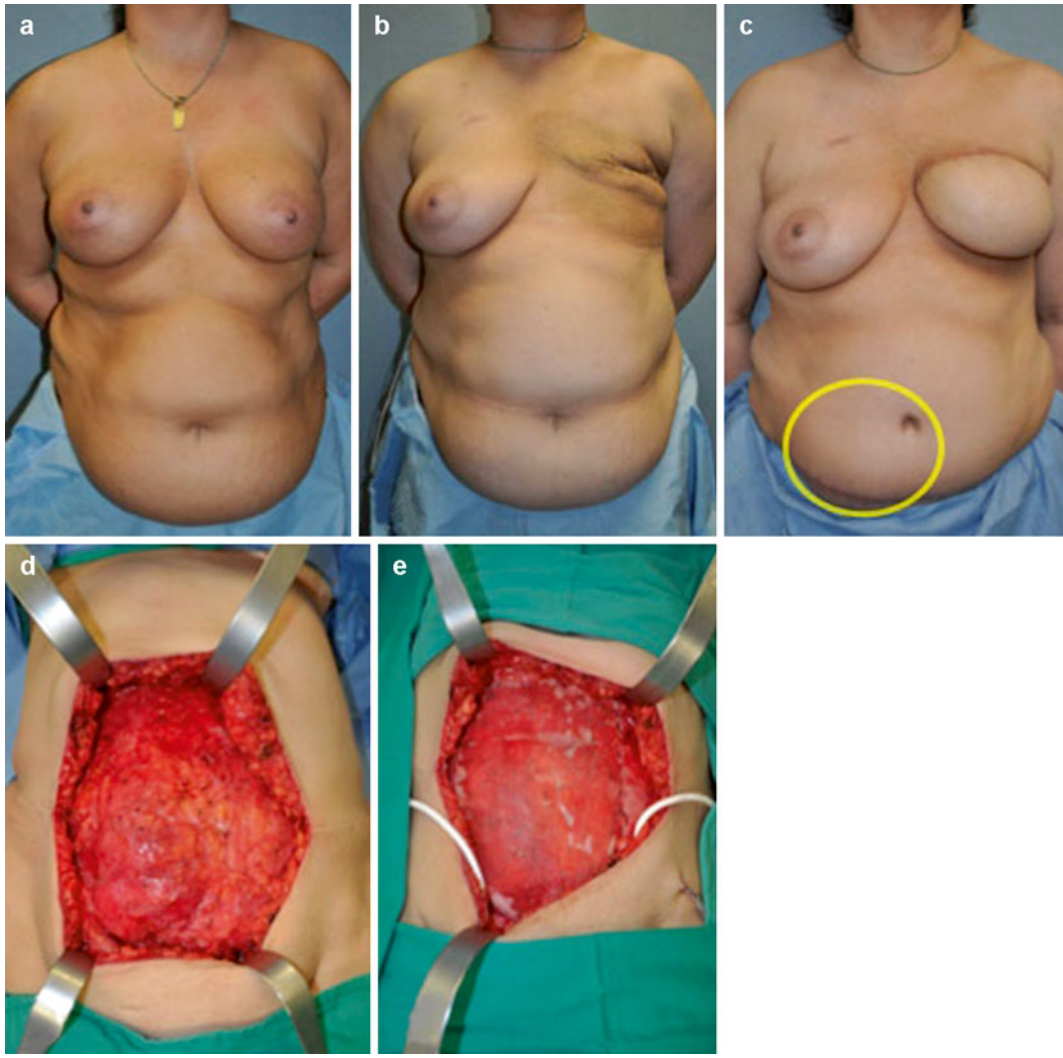

Fig. 131.9 Abdominal hernia. (**a**, **b**) Preoperative female presenting for autologous tissue reconstruction. Ample abdominal tissue as well as large, ptotic breasts and evidence of left chest irradiation injury are indications for autologous reconstruction. (**c**) Post-microsurgical free tissue transfer breast reconstruction from the abdominal donor site. Note the significant abdominal hernia located in the right lower quadrant at the site of flap harvest and pedicle dissection. (**d**) Intra-operative image of the abdominal hernia. (**e**) Reduction and repair of the abdominal bulge with prosthetic mesh material. Drains are left in place to prevent seroma formation around the foreign body

ated defects and a partially or completely failed breast reconstruction. It is important to discuss this possibility with each woman that may undergo autologous breast reconstruction, whether pedicled or free. For those women that suffer flap loss, alternative reconstructions can still be performed at a later time. Whether the subsequent reconstruction involves further attempt at autologous tissue reconstruction or conversion to an implant-based reconstruction should be a discussed thoroughly and all tools mentioned above employed.

Fig. 131.10 Autologous flap tissue loss. (**a**) Preoperative image demonstrating wound separation and partial flap loss along the medial aspect of transferred flap. (**b**) Image demonstrating complete flap loss with loss of the entirety of the exposed skin paddle as well as deepithelialized and buried portions of the tissue transferred

Conclusions

Breast reconstruction in the aged woman is associated with specific considerations which must be recognized by oncologic and plastic surgeon alike. It is our intent with this chapter to show that all forms of breast reconstruction are safe for the elderly individual. The authors hope that with this information, both reconstructive and oncologic surgeons will feel more confident in offering breast reconstruction to patients of all ages and that a wide variety of safe and effective breast reconstruction techniques are available to the aged women who is appropriately selected.

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