



Breast reconstruction in the high-risk population: current review of the literature and practice guidelines

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Abstract: Breast reconstruction is an important part of the cancer treatment paradigm and the psychosocial benefits are well described in the literature. Notably, breast reconstruction restores both the functional and emotional losses patients experience due to tumor resection. Post-cancer quality of life is an important benchmark of successful treatment; therefore, breast reconstruction is an essential component that should be offered whenever possible. Over time, reconstructive techniques and outcomes have improved dramatically resulting in better patient safety and decreased operative morbidity. When counseling a patient for surgery, the provider must consider all aspects of a patient's health. Ideally, breast cancer patients should be physically, emotionally, and oncologically appropriate candidates for reconstruction. However, in concerted effort to provide opportunities for as many patients as possible, the definition of who is a good candidate for reconstruction has evolved to include higher risk patients. These patients include those with advanced age, nicotine use, obesity, and significant ptosis. With improvements in surgical procedures and perioperative care, this population may also benefit from restorative surgery. However, the exact risk of complications and necessary counseling has gone largely undefined in this population. This article examines particular “high-risk” groups that may be challenging for extirpative and reconstructive surgeons and offers current guidelines for practice.

Keywords: High-risk; breast; reconstruction; obese; ptotic; elderly; smoking

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Introduction

Since the passage of the Women's Healthcare and Cancer Right's Act of 1998, breast reconstruction has fortunately increased in both frequency and number of options offered. Accordingly, important outreach initiatives have followed including an internationally-recognized annual Breast Reconstruction Awareness Day and other educational endeavors that improve patient's knowledge and access to care. Simultaneously, within the medical community, multidisciplinary care of the breast cancer patient has grown to routinely include medical, radiation, and surgical

oncology as well as plastic and reconstructive surgery.

While breast reconstruction remains a pillar of breast cancer treatment, not all patients may be appropriate candidates, based on medical, physiological, anatomic and oncologic conditions. Patients with high risk conditions may desire breast reconstruction, but may be counseled that the reason that they are “high risk” is that their medical conditions result in an increased likelihood of complications. Complications after breast reconstruction have been shown to affect patient emotional well-being, health-related quality of life, and satisfaction and should be considered prior to offering care (1-4). In this review,

such potential high-risk groups are defined and the current literature examined for the most up-to-date reconstructive recommendations.

Defining a high-risk population

Patients who are considered at increased risk for reconstructive surgical complications include those who present with medical diagnoses, or physical conditions that predispose them to infection, mastectomy flap necrosis, perioperative morbidity, or reconstructive failure. The consequences of these complications include pain, long-term disability, scarring, but of most importance, possible delay in adjuvant treatments that could affect oncologic outcome, or even survival. While a single high-risk factor alone may not preclude a breast reconstruction, patients with multiple risk factors should be judiciously evaluated and advised. The importance of defining high risk groups is to ultimately assess the risk of complications, and their potential effects on breast reconstruction patients.

High-risk groups

Elderly

Nearly 75% of breast cancer is diagnosed in patients over 65 years. With the rapidly increasing elderly population, breast cancer treatment providers must consider this select group. In the past, some surgeons did not offer reconstruction in elderly patients, with one study finding the biggest single predictor for offering reconstruction being a patient age under 50 years (5). With increasing breast cancer survival rates, this tendency may leave patients without reconstruction for decades. While age is always a consideration regarding the overall health and tolerance of a surgical candidate, increasing data across multiple disciplines have demonstrated that the global health of the patient is more predictive of successful outcomes than chronology alone.

In a recent review from the United Kingdom, the authors found that breast reconstructive surgery is well tolerated in the elderly population, with complication rates comparable to a younger group (6). Importantly, in areas such as social functioning and emotional well-being, patients with reconstructive surgery displayed better outcomes than those without. This data is reinforced by multiple other studies with similar findings, demonstrating both comparable safety and patient satisfaction in the elderly reconstructive

population (7-10).

Interestingly, many studies have also demonstrated that in the elderly population, autogenous reconstruction produced better results than implants (6,11,12). While there may be a bias to use implants in older women to reduce anesthetic time, decreasing long-term satisfaction, increasing complication rates, and increasing number of revision procedures may outweigh this perceived benefit (12-14). Furthermore, recent evidence suggests that age greater than 65 may be an independent risk factor for perioperative complications following expander/implant-based reconstruction (15). When evaluating the safety of autologous reconstruction in the elderly, a study in women older than 65 years versus women younger than 65 years found there was no significant difference in overall complication rates (16). Furthermore, on patient-reported measures, patient satisfaction was equally high between the groups. Similarly, Selber *et al.* found that free flaps in advanced age are well-tolerated without evidence of increasing complication rates and should be offered when indicated (17). Therefore, in the healthy elderly individual, neither method of reconstruction should be excluded and autologous tissue should be considered without prejudice.

When determining relevant risk factors in older populations, many studies have demonstrated that patient frailty may be more predictive of surgical complications than age (18). The Canada Study of Health and Aging (CSHA) developed a 70-item frailty index (CSHA-FI) that was based on this concept and assessed cognitive function, nutritional status, gait, grip strength, and comorbidities. The CHSA-FI has been shown to be strongly associated with adverse outcomes (19). The American College of Surgeons NSQIP database initially developed an 11 factor "modified frailty index" (mFI-11), and more recently, Subramaniam *et al.* have demonstrated a simplified 5-factor modified frailty index (mFI-5) that is equally effective predictor of mortality and postoperative complications in all sub-specialties (20,21). The factors comprising the mFI-5 include functional status, diabetes, history of COPD, history of congestive heart failure, and hypertension requiring medication. Cuccolo *et al.* examined patient frailty versus age on outcomes following pedicled flap reconstruction, including for breast cancer. Although increased age was associated with increased risk of complications, the 5-factor modified frailty index (mFI-5) held much stronger predictive capacity (22).

In summary, age should be considered a single factor in overall patient capacity for reconstruction, but should

not be used to as a method of exclusion. Perioperative risk stratification, such as using the mFI-5, is a better predictor of complications than age alone.

Smokers

For decades, smoking has been linked to cancer-related deaths and nicotine-induced vascular insufficiency. In the breast cancer patient, smoking is not only associated with higher risk of perioperative infection, but mastectomy flap necrosis, poor wound healing, and thrombosis.

In both alloplastic and autologous reconstruction, smoking has been found to increase the risk of developing post-operative complications (11,15,23-25). A study of independent risk factors for post-operative complications of autologous or implant-based reconstruction showed smoking was associated with the highest number of early overall complications. When smoking was combined with other potential risk factors such as obesity or preoperative radiation, the risk for complications rose exponentially (11). In a similar study looking at the effect of smoking on surgical complications with implant-based reconstruction alone, smoking was associated with an eightfold higher rate of complications than non-smokers (26). When examining the effects of smoking solely on autologous reconstructions, Chang *et al.* found that smokers were at significantly higher risk for mastectomy skin flap necrosis, abdominal flap necrosis, and hernia compared with non-smokers (23). Patients with a smoking history greater than 10 pack-years were noted to be at especially high-risk. Interestingly, no significant difference in complications was noted between former smokers and nonsmokers, when patients stopped smoking at least 4 weeks prior to surgery.

Although former smokers remain with an elevated lifetime risk of cancer, the reduced risk of perioperative complications has been replicated in multiple randomized controlled trials. A meta-analysis by Mills *et al.* pooled data from six randomized controlled trials regarding smoking cessation. Compared to controls, cessation programs were found to reduce overall risk of complications by 41%, postoperative wound healing complications by 52%, and surgical site infections by 60% (27). Furthermore, a significantly lower complication rate was observed in the trials which used a duration of smoking cessation 4 weeks or greater, with each week of smoking cessation progressively reducing postoperative risk out to six weeks.

The diagnosis of breast cancer can often induce anxiety and maladaptive coping mechanisms, including cigarette

use. However, during initial consultation the oncologic treatment team may have a counseling opportunity at a time when concerned patients are most receptive to the idea of smoking cessation. In a meta-analysis regarding the effectiveness of smoking cessation interventions, the authors found that a smoker had approximately 1 in 8 chances of quitting without aid (28). However, this rate was doubled with the use of nicotine replacement therapy (NRT) and more than doubled when smoking cessation medications were used appropriately. Interestingly, in a randomized controlled trial, smoking cessation with NRT was shown to reduce postoperative complications as much as smoking cessation alone (29). Therefore, while absolute nicotine cessation for at least 4 weeks is the optimal recommendation for patients, NRT and adjunct medications may provide the highest chance of adherence to a cessation regimen with minimal wound healing complications (30).

Obese

For a multitude of socioeconomic reasons, many industrialized nations are facing an increasing obesity epidemic. If current trends continue, 30% of the United States population will be obese (BMI >30 kg/m²) by 2050. Obesity contributes to chronic medical comorbidities such as hypertension, diabetes, and cardiovascular disease. In the breast reconstruction population, it is associated with increased risk of seroma, wound healing complications, infection, and reconstructive failure (15,26,31-41). In addition to perioperative morbidity, the aesthetics of breast reconstruction are challenged by large breast volume and truncal obesity.

Every reconstructive surgeon must decide their particular limit for different types of reconstruction in the obese patient. Importantly, different classes of obesity may do better than others. Hanwright *et al.* examined the differential effect of BMI on breast reconstruction in nearly 13,000 patients from multiple institutions (34). Overall, post-operative morbidity was significantly elevated in obese patients across all forms of reconstruction. In a large study by Fischer *et al.*, the authors demonstrated that progressive obesity, defined by the World Health Organization Class I-III obesity guidelines, was associated with higher rates of overall perioperative morbidity, length of stay, operative time, and anesthesia risk (33). In particular, Class III obese patients experienced a 5.3% higher risk of return to the operating room and a 1.7% higher rate of flap or implant loss within 30 days. Through a meta-analysis, Panayi *et al.*

found that obese women were 2.29 times more likely to experience surgical complications, 2.89 times more likely to have medical complications, and 1.91 times more likely to require reoperation in both prosthetic and autologous reconstruction (36).

In many practices, particularly within the United States, breast reconstructive surgeons are challenged by a patient population that is mostly obese, rather than by exception. If otherwise healthy, the surgeon must then determine the best method of reconstruction in this population. Several studies have evaluated obesity and type of reconstruction, with certain trends emerging.

Two recent publications evaluated patient-reported satisfaction and quality of life in obese patients undergoing autologous and implant-based reconstruction. The authors found that microsurgical breast reconstruction in obese patients yielded higher satisfaction with breasts, overall outcomes, psychosocial well-being, and chest physical well-being (37,38). Similarly, Garvey *et al.* analyzed surgical complications in 700 obese patients who underwent alloplastic versus autologous reconstruction (42). Obese patients, especially class II and III, experienced higher failure rates with implant-based reconstruction than autologous reconstruction, especially if performed immediately. In another study examining BMI and prosthetic breast reconstruction, every unit increase in BMI was predictive of a 5.9% increase in the odds of a complication occurring, and a 7.9% increase in the odds of reconstructive failure (32). In regards to specific patient-reported outcomes, limited implant volumes may also provide decreasing patient satisfaction trying to match increasing mastectomy volume. Therefore, when counseled appropriately relative to risk, patients may have greater long-term satisfaction with autologous reconstruction than with implants.

In obese patients who may otherwise not be candidates for tissue transfer, newer literature offers methods to improve outcomes with implant-based reconstruction. Prepectoral placement of tissue expanders with biologic mesh has proven to be safe and decrease pain and animation deformity, while increasing projection on the chest wall (43,44). Indeed, retropectoral placement of tissue expanders may cause a concavity of the rib cage over time that is difficult to overcome with standard size implants in large women. A large study of outcomes after prepectoral implant reconstruction found that despite a tendency for class II and III obese patients to experience increased perioperative morbidity and reconstruction loss, on multivariate analysis

the presence of diabetes and smoking were more predictive of any complication than obesity (45). These results suggest that while obesity should be considered, the global health of the patient and control of obesity-associated morbidities should be considered prior to exclusion from implant-based reconstruction.

Lastly, several studies have evaluated the role of oncoplastic reconstruction versus immediate prosthetic or autologous reconstruction. Tong *et al.* showed that oncoplastic patients were generally older, more obese, and had more comorbidities than their counterparts, yet they experienced fewer major complications requiring operative management, fewer complications delaying adjuvant treatment, and fewer incidences of hematoma/seroma formation (46). Furthermore, oncoplastic breast reconstruction was an independent protective factor against major complications and complications that delayed adjuvant therapy. Therefore, in obese patients, especially those that are superobese or present with additional comorbidities, oncoplastic breast reconstruction may be the safest option.

Ptoisis

The breast cancer patient with grade II or III ptosis is a difficult reconstructive dilemma. The excess skin envelope makes control of the breast pocket difficult, mastectomy skin flap perfusion questionable, and, in nipple-sparing mastectomies, symmetric position of the nipple-areolar-complexes is extremely unpredictable. Traditionally, many patients with significant ptosis or macromastia are not offered nipple-sparing mastectomies or single-stage reconstructions. However, the improving survival of breast cancer patients, as well as the focus on post-cancer aesthetics and quality of life, no longer makes this limitation acceptable to patients (47). Several authors have described advances in control of the breast pocket and surgical techniques to increase the dependability of nipple-sparing mastectomies.

In 1990, Bostwick described his technique utilizing excess skin in the ptotic breast at the time of mastectomy as a deepithelialized inferiorly-based dermal flap and closure of the breast pocket in a Wise pattern (48). The Bostwick "Autoderm" technique has been described in multiple variations since, as a way to manage a redundant breast pocket while utilizing well-vascularized flaps over prostheses or expanders (49-54). Instead of disposing unnecessary lower pole tissue, the dermal flap becomes an essential part of the lateral and inferior pole borders and

decreases the mechanical stress on mastectomy skin. Similar to the benefits of biologic mesh, the dermal pocket then defines the breast shape and allows the skin to be closed in a more aesthetic fashion (55). By maintaining the subdermal vascular plexus of the inferior flap, watershed areas that are often tenuous in a classic Wise pattern skin closure also have improved perfusion. The autoderm technique is now also used in prepectoral fashion when excessive laxity permits. This method has the added benefit of mitigating procedure costs, if used in lieu of acellular dermal matrix in appropriate cases.

Nipple-areolar preservation in the ptotic population is another domain receiving increased emphasis. To improve cosmesis in grade II and III ptosis, staged techniques for nipple-sparing mastectomy have been described by several authors (56-58). In 2012, Spear described a three-stage approach to spare the NAC in which women first underwent an oncoplastic mastopexy/reduction, followed by a completion mastectomy through the mastopexy incisions, and then the final reconstruction with a prosthesis (59). This approach was demonstrated to be safe and effective with excellent aesthetic results. However, this technique was isolated to patients with small, peripheral tumors and negative nodal exams or patients undergoing prophylactic mastectomy. Patients with multicentric disease were excluded for oncologic safety. In response to this, Schwartz *et al.* developed an alternative staged technique suitable for both multicentric and isolated cancers, even in high-risk patients. Patients would first undergo NSM via a limited lateral incision, completion Wise pattern incision in the office 10 days later, operative repositioning of the skin and NAC two weeks later, and final prosthetic placement with acellular dermal matrix at 3 months (56). In both methods, the skin-reduction techniques are also useful in unilateral breast cancer reconstructions, because the same pattern can be applied to the contralateral side for symmetry (50,51,60).

Mastopexy at the time of mastectomy has also been employed to improve autologous reconstruction results as well. Lin *et al.* investigated skin-sparing mastectomies with Wise pattern versus vertical mastopexy incision followed by immediate autologous reconstruction (61). Their results demonstrated acceptable results with both techniques, although there was a higher rate of mastectomy flap necrosis in the Wise pattern group. Rochlin *et al.* described a nipple-sparing technique using NAC delay procedure, followed by mastectomy via a lateral incision and Wise pattern in-folding of the dermis, and immediate autologous

reconstruction (58).

Across all techniques, the surgeon capitalizes on the subdermal plexus to preserve vascularity to the mastectomy skin or nipple. This requires careful coordination with the surgical oncologist regarding incision placement and mastectomy flap thickness. Grade II or III ptosis is not a contraindication to any one type of breast reconstruction, but deserves a multidisciplinary approach to the timing of neoadjuvant, adjuvant, and surgical care.

Summary

- (I) Elderly patients may be excellent candidates for breast reconstruction if otherwise healthy. Withholding autologous reconstruction is not recommended and may serve an older patient better by limiting the need for excessive revision operations;
- (II) Smoking is contraindicated in all forms of breast reconstruction with prohibitively large complication rates. At least four weeks of abstinence is recommended, although the use of nicotine-replacement and associated medications may be permitted. Any patient that cannot comply should be offered delayed reconstruction;
- (III) Obese patients present with multiple risks due to habitus and associated comorbidities, such as diabetes. Due to increased likelihood of prosthetic complications or failure, autologous and oncoplastic breast reconstruction are recommended;
- (IV) Ptotic patients may be best managed by a staged approach, especially if they have grade III ptosis or desire a nipple-sparing mastectomy. Skin and nipple-areola perfusion are paramount and require a coordinated approach between breast and plastic surgeons.

Conclusions

When providing breast cancer treatment and reconstruction, all providers must consider the global health of the patient as well as the physical characteristics. High-risk patients should not be reflexively excluded from certain types of reconstruction, but counseled appropriately according to best evidence.

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