

Breast Reconstruction after Bilateral Prophylactic Mastectomy in Women at High Risk for Breast Cancer

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■ **Abstract:** Several studies have shown the effectiveness of bilateral prophylactic mastectomies (BPM) at reducing the risk of developing breast cancer in women by more than 90%. A growing number of women at high risk for breast cancer are electing to undergo prophylactic mastectomy as part of a risk reduction strategy. This unique group of women frequently chooses to undergo reconstructive surgery as a part of their immediate treatment plan. Breast reconstruction after BPM has profound physiological and emotional impact on body image, sexuality, and quality of life. These factors should be taken into consideration and addressed when consulting the patient prior to BPM and reconstructive surgery. The timing of reconstructive surgery, the type of mastectomy performed, the reconstructive modalities available, and the possibility to preserve the nipple–areola complex, should all be discussed with the patient prior to surgery. In this article, we review our experience and the current existing literature on breast reconstruction for high-risk women after BPM. ■

Key Words: BRCA I-II, breast cancer, breast reconstruction, family history, microsurgery, prophylactic, reconstruction

Public awareness regarding breast cancer risk has increased due to the advances in detecting breast cancer susceptibility genes, mainly BRCA1 and BRCA2, and the availability of commercial mutation testing kits. The growing number of prophylactic mastectomies will inevitably result in more women seeking reconstructive surgery counseling, as evidenced by the doubling of contralateral prophylactic mastectomy performed in the United States (1).

Although mastectomy as a means of surgical prophylaxis for patients at high risk for breast cancer still remains a somewhat controversial procedure, studies suggest that of the currently existing strategies, bilateral prophylactic mastectomy (BPM) is the most effective in reducing the risk for breast cancer in high-risk women (2–4).

In our reconstructive institute, we are seeing a definitive increase in both the number of women seeking counseling for breast reconstruction after BPM, and also in the number of women inquiring about

reconstructive options for contralateral prophylactic mastectomy. This review will focus on women at high risk for breast cancer opting for bilateral breast reconstruction after BPM.

PATIENT COUNSELING

We strongly encourage a multi-disciplinary group approach be adopted based on our own experience at our institute. This team should ideally include a geneticist, an oncologist, a general surgeon, a plastic surgeon, a specially trained nurse, a psychologist, and a gynecologist. This approach is available to the patient with the intent of providing thorough information and answers to all questions prior to embarking on BPM and bilateral breast reconstruction (5,6).

Interestingly, in a study that included 684 women that underwent prophylactic mastectomies, nearly two thirds of the women communicated their desire to have had more information on a variety of topics prior to surgery, most notably, reconstruction and prostheses (5). Of 684 women, those undergoing BPM reported more informational need than those who underwent contralateral prophylactic mastectomies and were significantly more interested in getting increased information about reconstruction options and implants. Thus the importance of extensive

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patient education cannot be over emphasized in this unique patient population, particularly by the reconstructive plastic surgeon. Specific reconstructive topics warranting discussion with the patient are listed in Table 1.

THE MASTECTOMY

The goal of all mastectomy techniques is the removal of all breast tissue, leaving behind as little residual as possible; still no form of mastectomy can completely eliminate all breast tissue (7,8). From a reconstructive point of view, the most important aspect of the mastectomy is the breast skin envelope that is left behind to cover the breast mound.

Skin sparing mastectomy preserves most of the breast skin envelope but removes the nipple-areola complex (NAC) altogether, thus requiring the reconstruction of the NAC at a future date, if the patient so wishes. The total preservation of the NAC requires a nipple-areola sparing mastectomy also referred to as subcutaneous mastectomy (9). Opponents of the nipple-areola sparing mastectomy point to the fact that breast tissue and ducts are left behind when this approach is chosen. We and others offer our BPM patients the option to undergo areolar sparing mastectomy in which the nipple is removed but the areola is spared. This technique is a compromise between the total removal of the NAC and subcutaneous mastectomy which preserves the NAC, thus the areola is maintained and only the nipple needs to be reconstructed. Current techniques for areola reconstruction are mainly based on tattooing of a pigmented circular area. Unfortunately, this technique falls short of recreating the natural appearance of the areola. Thus, areolar sparing mastectomies provide the patient with a

more natural look of the NAC and the reconstructed breast.

It is crucial that an extensive discussion regarding preservation of the NAC be held with the patient prior to BPM. This is demonstrated by the lower patient satisfaction rate achieved with nipple-areola reconstruction compared to the overall aesthetic results reported in a study on the aesthetic outcome after BPM and immediate reconstruction (10).

TIMING OF RECONSTRUCTION: IMMEDIATE VERSUS DELAYED

Unlike therapeutic mastectomy for breast cancer, BPM is an elective procedure and offers the patient the option of choosing the timing of reconstruction. We and others have found that higher patient satisfaction and better aesthetic results can be achieved in immediate breast reconstruction versus delayed reconstruction (11,12). Hence, when opting for immediate reconstruction, the patient should be aware that in the rare event that an occult malignancy is found in the resected specimen, axillary lymph node sampling, and adjuvant therapy (irradiation and/or chemotherapy) may be warranted. The patient should understand that these additional treatment modalities might compromise the final aesthetic result. In one study, which included 550 women 15 (2.7%) were found to have occult malignancy (of note, this study included both BPM and contralateral prophylactic mastectomy cases) (4). Thus, even though occult metastases are rarely found, the patient should be well informed of this possibility and the possible consequences the additional treatment modalities needed might have on the aesthetic outcome (13-15).

Immediate breast reconstruction offers more than just cosmetic benefits, the patient recovers from the BPM with a reconstructed breast mound and does not have to live with the mastectomy deformity for any period of time. Recent studies have dismissed earlier notions on delaying the reconstruction for both psychological benefits (16) and the supposed higher satisfaction (17) after living with the deformity. Since then, several published studies have commented on the psychosocial benefits for patients undergoing immediate breast reconstruction compared with delayed breast reconstruction, showing lower incidence of psychological morbidity postoperatively (18-20).

In a study comparing 38 immediate breast reconstruction patients with 83 delayed reconstruction

Table 1. Specific Reconstructive Topics for Preoperative Discussion

1. Timing of reconstruction
2. Risks and Benefits of autologous versus implant reconstruction
3. Types of autologous procedures available to the patient based on their body habitus
4. Types of implants available for reconstruction
5. Possible need for nipple and areola reconstruction and loss of sensation
6. Need for future oncologic surveillance
7. Expected recovery time and postoperative course (getting back to every day activity, getting back to work, exercise, etc.)
8. Breast and donor site scars
9. Possible complications (breast and donor site)
10. Possible need for future surgery (implant replacement, cosmetic touch-ups, revisions, etc.)

patients, the immediate reconstruction patients scored significantly better on body image and self-esteem; the delayed reconstruction patients felt significantly greater anxiety, depression, and impairment of their sexual attractiveness relative to the immediate reconstruction patients (21). Another prospective, randomized study on immediate reconstruction post-mastectomy has shown reduction in psychiatric morbidity by the increase in freedom of dress, less repulsion at naked appearance, and less marital stress (18).

RECONSTRUCTIVE SURGERY

Breast reconstruction can broadly be subdivided into autologous based, versus implant based, versus combined autologous and implant reconstructions. The gold standard for all breast reconstructions to date is autologous reconstruction, with the abdominal tissue being the primary donor site.

The selection of the reconstructive technique should be made by the patient after she has been well educated on the available reconstructive options, and understands the risks and benefits of each procedure. Tailoring of the appropriate reconstructive modality is a combined task of both the plastic surgeon and the patient. In general, the women opting for BPM are of a younger age group compared to women undergoing therapeutic mastectomy. These younger women tend to exhibit a slimmer body habitus and are often nulliparus, thus the availability of abdominal tissue and abdominal laxity are at times limited. This may require the use of alternative autologous donor sites, such as the latissimus musculocutaneous flap or flaps based on the microvascular transfer of gluteal or thigh tissue. Implant-based reconstructions are also a viable option when autologous tissue is lacking or when initially chosen by the patient.

AUTOLOGOUS RECONSTRUCTION

The abdomen is considered an excellent donor site mainly due to its soft tissue characteristics, mainly fat, that closely resemble breast tissue. The transfer of the abdominal tissue to recreate the breast mound can be achieved as either a pedicled transverse rectus abdominis muscle (TRAM) flap, or as free tissue transfer (microvascular surgery). Microvascular transfer of the abdominal tissue can be in the form of a free TRAM flap, a deep inferior epigastric perforator (DIEP) flap, or a superficial inferior epigastric artery (SIEA) flap

(22). The likelihood of a ventral hernia or an abdominal bulge is greater when greater amounts of rectus fascia are incised and when more rectus muscle is removed (23). Newer techniques of free abdominal tissue transfer allow for less trauma to the rectus muscle and fascia, thus preserving abdominal wall integrity. While the muscle sparing free TRAM involves the harvest of a small amount of rectus muscle with the flap (possibly causing partial denervation of the remaining muscle), the DIEP flap does not entail the harvest of any rectus muscle. Furthermore, the use of the SIEA flap results in no disruption of the anterior rectus fascia whatsoever, thus maximal preservation of the abdominal strength is achieved. This is especially true when opting for bilateral breast reconstruction (24).

As mentioned earlier, the often younger patients opting for BPM might not exhibit sufficient abdominal tissue or laxity for BPM. The latissimus dorsi muscle flap with or without a skin paddle is a commonly used flap in breast reconstruction. This flap is most often rotated from the back to the chest on its vascular pedicle (thoracodorsal vessels) and is usually augmented with an implant to supply sufficient volume to recreate the breast mound. In these cases the implant should be fully covered by the latissimus muscle inferiorly and the pectoralis major muscle superiorly. In women with heavier body habitus this flap can be used on its own by harvesting a more extended flap thus avoiding the need for an implant. A skin paddle can be transposed with the muscle (musculocutaneous flap) whenever needed. (See Figs. 1 and 2 for a representative case).

When abdominal tissue is not available, non-abdominal free flaps can be based on the gluteal artery perforator system, such as the superior gluteal artery perforator (SGAP) flap and the inferior gluteal artery perforator (IGAP) flap. The transverse upper gracilis (TUG) flap is also a good option, the donor site being the upper medial thigh region.

IMPLANT-BASED RECONSTRUCTION

Tissue expanders and implants (both saline and silicone filled) are often used for post-BPM reconstruction (25). An educational discussion should be conducted with the patient on both the choice of implant type and the realistic size of implant appropriate for her body figure. Underfilled tissue expanders are often used at the initial reconstruction as an interim phase. This avoids the additional vascular

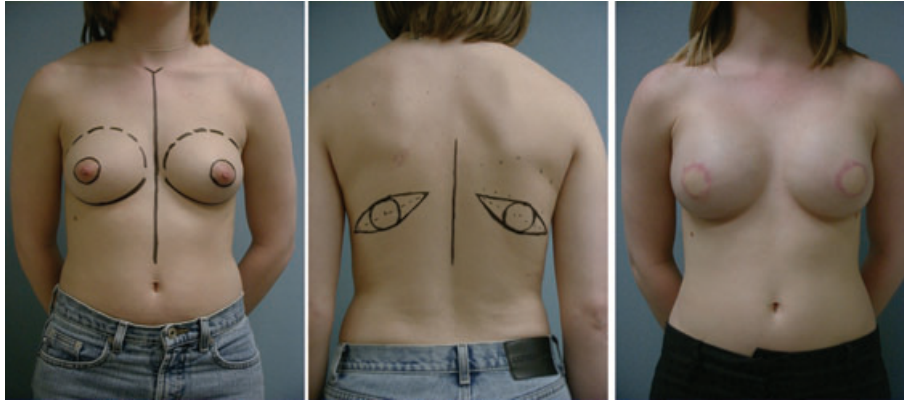


Figure 1. Case 1. This 20-year-old female presents with a strong family history of breast and ovarian cancer. The patient presented for consultation regarding her reconstructive options in light of the BPM she is pursuing. She is nulliparous and exhibits no lower abdominal laxity. Thus the latissimus dorsi myocutaneous flap with the placement of submuscular implant was chosen as the procedure of choice. *Right:* Preoperative markings for bilateral skin sparing mastectomy. *Center:* Preoperative markings of the latissimus dorsi myocutaneous flaps. *Left:* The patient is shown after completion of the first stage of reconstruction which included the bilateral skin sparing mastectomy, transfer of bilateral latissimus dorsi myocutaneous flaps, and insertion of bilateral implants.



Figure 2. Case 1. *Top:* Preoperative views. *Bottom:* Postoperative views after bilateral skin sparing mastectomy and reconstruction with bilateral latissimus dorsi myocutaneous flaps, and insertion of bilateral implants. The nipple has been reconstructed by transposing small skin flaps from central a skin island of the latissimus dorsi myocutaneous flap. The nipple–areola complex was then tattooed to achieve the final result shown.

compromise that might ensue if a full implant is placed under the thin mastectomy skin. Tissue expanders are also used to recruit more skin envelope if skin is deficient or if a bigger implant is desired at a

later stage. The use of tissue expanders requires serial expansions with saline on multiple office visits. At a later stage the tissue expander is usually replaced with a permanent implant.

Newer generation implants referred to as bio-dimensional or “anatomical” implants are designed to achieve a more naturally appearing breast mound (26). Others have described the utility of single stage immediate breast reconstruction with adjustable implants in a large patient group with reported good-to-excellent aesthetic results in 95% of patients as assessed by the patients and physician (27).

To avoid the direct placement of breast implants under mastectomy skin, recent advances allow for the use of grafted dermal matrix substitutes as an added layer between the implant and the mastectomy skin flap. In this type of reconstruction the superior pole of the implant is placed in submuscular plane (under the pectoralis major) while the remaining inferior pole is covered by a dermal matrix graft such as Alloderm® (Lifecell Corp.) (28–30).

Implants and tissue expanders can additionally be used in combination with autologous tissue transfer when more volume is desired. As mentioned previously implants are often placed under latissimus dorsi flaps to augment both the size and the projection of the breast mound. Recently, we have begun placing implants under both DIEP flaps and SIEA flaps in patients requesting larger breasts. In this manner the implant is covered by the overlying flap and thus a more natural filling and aesthetically pleasing reconstruction is achieved when compared to the implant being placed directly under the thin mastectomy skin. This is especially true in the younger and quite often slimmer patient population undergoing BPM (see Figs. 3 and 4 for a representative case).

PATIENT SATISFACTION WITH PROPHYLACTIC BREAST RECONSTRUCTION

Several published studies have aimed at assessing general and aesthetic satisfaction rates in women undergoing prophylactic mastectomy and immediate breast reconstruction (10,31–35). Satisfaction rates after BPM and breast reconstruction are reported in the range of 70% (31) to 100% (34), although it is difficult to accurately quantify patient satisfaction due to various mastectomy and reconstructive techniques used in the different reports. Factors affecting patient satisfaction are summarized in Table 2.

Women undergoing BPM are often younger than their matched therapeutic mastectomy counterparts and exhibit higher aesthetic expectation. Dissatisfaction with BPM and breast reconstruction has been shown to

have meaningful negative effects on body image and the patient’s sexual life and correlates directly to dissatisfaction with final aesthetic result (36,37).

Proper patient education prior to surgery is one of the key determinants in obtaining high satisfaction rates in this distinct patient population. The possibility of having both the mastectomy and the reconstructive surgery done as elective procedures often spawns higher expectations. Thus, realistic expectations should be set forth. We have found that a photo album showing previous similar cases is an excellent means of patient education. We recommend that both good and modest results be shown in this album, to set pragmatic expectations. A thorough discussion of possible complications and their treatment with the patient is obligatory; “plan B” options should be mentioned.

As is true with all plastic and reconstructive surgery patients, satisfaction is both objective and subjective. Patient satisfaction will relate not only to the final surgical outcome, but also to a multitude of complicated psychosocial issues that each individual patient experiences through her breast reconstruction process and battle with cancer (37).

NIPPLE–AREOLA COMPLEX RECONSTRUCTION AND BREAST SENSITIVITY

Aesthetic satisfaction after breast reconstruction is highly influenced by the presence of nipple–areola reconstruction (38,39). BPM patients choosing to undergo breast reconstruction should be presented with the option of preservation of the NAC in total—or at least the areola with reconstruction of the nipple only. The patient should be aware of the remote possibility of malignant transformation that might occur in the minute amount of breast tissue left in the nipple ducts. Still, as previously mentioned no type of mastectomy removes 100% of breast tissue regardless of nipple preservation. Various techniques have been described for reconstructing the nipple–areola, yet none can fully and accurately reproduce the native structure. Factors patients disliked most about their nipple–areola reconstruction were, in descending order, lack of projection, color match, shape, size, texture, and position (37).

In a study aimed at assessing sensibility in patients undergoing BCM with immediate implant reconstruction, 24 women underwent somatosensory testing 2 years after the latest surgery. In this study most patients reported decreased sensitivity in the breasts,

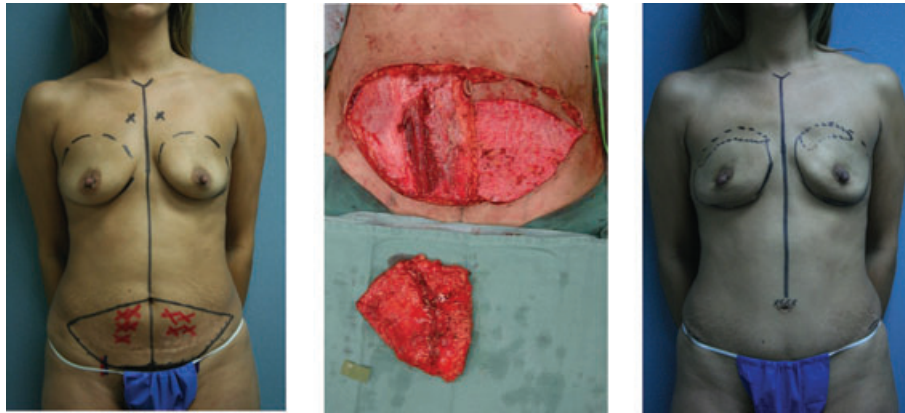


Figure 3. Case 2. A 37-year-old female presents with the diagnosis of bilateral fibrocystic disease and a strong family history of breast cancer. Due to the strong family history she wishes to undergo BPM and immediate reconstruction. Despite her slim body habitus she presents with lower abdominal redundancy and laxity due to two previous pregnancies. Thus she is a good candidate for autologous reconstruction using her abdominal tissue. *Right:* Preoperative markings. *Center:* The abdominal donor site is shown with the right DIEP flap ready for microsurgical anastomosis at the breast site. The left DIEP flap has also been dissected and deepithelialized but remains connected in situ for the time being. *Left:* The patient is shown in the interim after bilateral nipple–areola sparing mastectomy with bilateral transfer of DIEP flaps prior to insertion of implants. The transferred flaps serve as an important autologous tissue layer under the thin mastectomy skin flaps, covering the implants.



Figure 4. Case 2. *Top:* Preoperative views. *Bottom:* Final postoperative views after bilateral nipple–areola sparing mastectomy with bilateral DIEP flap reconstruction, and insertion of bilateral 400cc silicone implants. The implants were inserted 10 months after the initial BPM and DIEP reconstruction.

which was confirmed by the results from the somatosensory testing. The results also showed that the ability to experience erogenous sensation in the breast is

usually lost after this type of operation (40). In a second long-term study on women undergoing non-autologous immediate reconstruction (not prophylactic),

Table 2. Summary of Factors Shown to affect Patient Satisfaction

1. Type of mastectomy relating mainly to the preservation of nipple–areola complex
2. Overestimation of breast cancer risk as an indicator of overall lower satisfaction rate
3. Preoperative expectations from BPM and breast reconstruction, relating directly to preoperative patient education
4. Perioperative and postoperative complication relating to both BPM and/or the reconstructive surgery
5. Time interval to full recovery
6. Type of reconstructive surgery undertaken, e.g., autologous versus implant
7. Acceptance and satisfaction with new body image
8. Aesthetic satisfaction with reconstructed nipple–areola complex
9. Altered sensation in reconstructed nipple–areola complex
10. Final softness/firmness of reconstructed breast
11. The feeling of the reconstructed breast as belonging to the patients own body
12. Partner's perception of decrease in patient's femininity and/or sexual relationship
13. Ongoing physical complaints, discomfort and limitations in daily life
14. Breast symmetry

statistically significant impairment concerning the perception threshold sensibility to touch, cold, warmth, heat, and pain in the immediately reconstructed breast was demonstrated. This was in accordance with the patients' report of weaker overall sensibility in the reconstructed breasts. As concluded by the authors, these results attest to the importance of providing women facing mastectomy adequate and thorough information about what they can expect as far as sensibility is concerned (41).

Breast re-innervation after autologous breast reconstruction has been known to occur spontaneously, and is assumed to occur in a centripetal fashion by means of nerve end growth (42,43). Nonetheless, we and others have found that re-innervation in free flaps by means of nerve repair restores sensation earlier postoperatively, and also achieve an increase in the quality and quantity of sensation in the flap (44–46).

COMPLICATIONS AFTER BPM AND BREAST RECONSTRUCTION

Complication rates after BPM with or without reconstruction have been reported in the ranges of 3% (34) to as high as 66% (47). The Mayo clinic published their experience with reoperations in 523 women who underwent BCM with implant reconstruction. Of these women 95% underwent subcutaneous mastectomy. Approximately one-half of the women required at least one unanticipated reoperation

during a median follow-up of 14 years. Approximately 39% of all reoperations occurred within 1 year of breast reconstruction and 69% within 5 years. Implant-related issues were the most common cause for reoperation (59%), non-implant aesthetic issues 15%, postoperative reoperations 12%, and nodule removal 10%. Capsular contracture was the most common indication for implant-related reoperation (48).

In a study by Spear et al. (34) in which both autologous and implant-based techniques of reconstruction were used after unilateral prophylactic mastectomies a total of 3% complication rate in 101 breast-sites was noted. Two were infections in reconstructions utilizing tissue expanders, one of which included a latissimus dorsi flap concomitantly. A third patient suffered necrosis of the mastectomy flap after undergoing nipple–areola sparing mastectomy with free TRAM reconstruction.

In summary, during the initial consult patients should be educated on both the immediate perioperative and late postoperative complications. Immediate complications are more common in autologous-based reconstructions due to the presence of an additional wound at the donor site, but are usually self resolving without need for intervention (mainly seromas and hematomas). Late complications are more common with implant-based reconstructions with the possibility of implant exposure, leakage, and development capsular contraction causing breast distortion and/or pain, which might appear even years after the reconstruction has been complete.

CONCLUSION

Women electing to undergo BPM and breast reconstruction are a very unique group of patients. They are quite often younger healthy women in the prime of their life having to make a conscious decision to undergo a procedure that can have a drastic effect on their whole body image. This specific patient population has different psychological needs and aesthetic expectations.

Choosing the appropriate reconstructive technique to achieve satisfactory results often entails multiple factors such as, patient desire, body habitus, available tissue for autologous reconstruction and the surgical expertise of the reconstructive surgeon. A multi-disciplinary team approach and thorough patient education are key factors in achieving high patient satisfaction and optimal results.

Disclosure

The authors have no conflicts of interest to declare.

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