Breast Reconstruction following Mastectomy: Indications, Techniques and Results

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INTRODUCTION

p2990   Breast cancer affects more than 1 of every 10 women in the United States, requiring large numbers of women to undergo breast surgery. Many women who are appropriate candidates will choose to undergo breast-conserving therapy (BCT), comprising lumpectomy with postoperative radiation, which has been shown to have equivalent survival rates to the more disfiguring mastectomy. However, certain absolute and relative contraindications to BCT exist, making approximately 25% of patients with stage I or II disease medically more appropriate for mastectomies. More severe cancers are also more appropriately managed with mastectomies. Additionally, approximately 20% of patients who are candidates for BCT opt for mastectomy on the basis of personal choice. Furthermore, some women with a strong family history of malignancies including maternal lineage breast cancer are considered at high risk for developing breast cancer. They may chose to undergo genetic testing for *BRCA1* or *BRCA2* mutation as well. Many of these patients select bilateral prophylactic mastectomy with reconstruction and oophorectomy. Some patients choose to have no breast reconstruction, whereas others choose either immediate or delayed reconstructions. Overall, close to 75,000 women undergo breast reconstruction each year.

p3000   Women undergoing immediate or early reconstructions comprise less than 20% of mastectomy patients. However, this number is on the rise, partially as a result of the Women's Health and Cancer Rights Act of 1998, which mandates that medical insurance companies cover the costs associated with reconstruction of the affected breast, as well as procedures to the contralateral breast to enhance symmetry. As more women undergo mastectomies and seek reconstructions, the reconstructive options available have expanded. Patients currently may choose between reconstruction with implants of several varieties and reconstruction with autologous tissue from the back, buttocks, or abdomen, either as pedicled flaps to preserve blood supply or as free tissue transfers.

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ONCOLOGIC SURGERY

p3010   Optimal postoperative results occur when the oncologic, ablative surgeons work in concert with the aesthetic, reconstructive surgeons. Although the primary goal during a mastectomy should first and foremost always be eradication of tumor, several current trends facilitate breast reconstruction. Skin-sparing mastectomies, preservation of the inframammary fold, and conservation of blood vessels within the remaining subcutaneous and chest wall tissue play important roles in improving the appearance of the reconstructed breast.

p3020   In patients who have tumors of limited size without inflammatory characteristics or frank involvement of the overlying skin, the sacrifice of as little skin around the nipple areolar complex as possible allows greater leeway in reconstructive options. In certain circumstances, this can eliminate the need for tissue expansion before placement of a permanent implant or can allow for complete camouflage of breast scarring within the confines of a reconstructed nipple areolar complex. Preserving the integrity of the residual skin and subcutaneous tissue flaps by gentle handling, maximizing thickness, and minimizing electrocautery trauma will also promote postoperative aesthetics by decreasing skin loss, fat necrosis, scarring, and contracture of the native chest tissue.

p3030   The inframammary fold (IMF) is one of the most crucial landmarks of the breast, visibly defining its boundaries to a large extent, and slight discrepancies of placement of the IMF between sides of a patient can lead to poor approximation of aesthetic ideals. In some patients, these differences exist preoperatively and necessitate specific manipulation of the area during breast reconstruction because surgery on the breast may often unmask or emphasize abnormalities that were previously camouflaged by breast tissue, unnoticed by the patient or unimportant to the patient's self-esteem. The IMF must also be reconstructed when its boundaries are violated to ensure optimization of the oncologic portion of the breast procedures. However, manipulation of the IMF is difficult and prone to complications and poor results, and thus preservation of the IMF when possible greatly enhances the ease of breast reconstruction.

p3040   Conservation of blood vessels from the internal mammary artery and vein that perforate the chest wall and supply the subcutaneous tissue left behind after adequate mastectomy also facilitates reconstruction. Most notably, these vessels can be useful as recipient vessels in microvascular anastamoses that are necessary for free tissue transfer and may be used to augment blood supply in pedicled procedures as well. Other options exist should these vessels be sacrificed or be found to be of inadequate size; however, their preservation also ensures optimal vascularity and therefore health of the native breast flaps that will surround any reconstructive effort.

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TIMING OF RECONSTRUCTION

p3050   As previously mentioned, breast reconstruction may be performed either immediately postmastectomy or as a delayed procedure. Often this decision is left to patient preference. It is no longer believed that patients must live with a mastectomy defect to be able to decide whether they would benefit from reconstruction. However, certain medical reasons occasionally lead health care providers to recommend delayed rather than immediate reconstructions. Patients who will require extensive postoperative radiation therapy are often counseled to delay breast reconstruction. Additionally, patients with advanced local disease or nodal metastases who will be enrolled in chemotherapy protocols must understand that any reconstructive complication that delays wound healing could delay institution of necessary, life-preserving chemotherapy. Additionally, certain patients are not optimal candidates for breast reconstruction because of concomitant medical illnesses. These patients may be counseled regarding the possibility of reassessment at a later date.

p3060   As a whole, patients undergoing immediate versus delayed reconstructions are all still candidates for the entire spectrum of reconstructive options. However, patients undergoing delayed procedures do present a unique set of challenges. The most striking of these is reduction in the breast skin envelope. Following mastectomy without reconstruction, the skin of the chest will contract, necessitating tissue expansion before implants or larger skin islands in autologous repairs. Additionally, scarring makes the tissue planes more difficult to appreciate and preserve during recreation of a breast pocket for placement of the volume of the breast substitute. These are well-known phenomena that may be controlled with adequate preoperative planning.

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RECONSTRUCTIVE GOALS

p3070 The goal of any breast reconstruction is to imitate the contralateral natural breast as closely as possible. Breast reconstructions are judged on size, shape, symmetry, softness (or texture), and sensuality. Different patients have different expectations. Some will strive only to look balanced while fully clothed. Others will expect a breast that looks and feels natural when nude. It is essential that the reconstructive surgeon be involved as early as possible in the preoperative planning period to counsel the patient regarding reconstructive outcomes. Figures 12.13-1 through 12.13-5 detail Au65 various options for reconstructive surgery.

p3080   Although reconstructions can often achieve all goals, certain breasts are more difficult to reconstruct. Recreation of particularly large breasts may be beyond the plastic surgeon's reconstructive capabilities. Older patients often display significant ptosis and involutional changes on the unaffected side. Reconstructions are rarely able to mimic adequately the aged breast, so patients requesting symmetry must be prepared for operations on the contralateral breast, which can add to the scar burden but will likely result in overall rejuvenation of the breast appearance. Additionally, patients must understand the risk of complications from the additional procedures, which are largely specific to each reconstructive technique.

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IMPLANT RECONSTRUCTION

p3090 Some patients will choose or be counseled to choose implant reconstruction. This involves placement of a liquid- or gel-containing prosthetic into the breast cavity. Implants are often recommended for patients who are thin and thus have insufficient autologous donor tissue on their abdomen, back, or buttocks; who are medically ill and unable to undergo lengthy autologous reconstruction; who are averse to additional scarring on other parts of their bodies; and who are not candidates for or prior recipients of radiotherapy.

p3100   The implants currently available include permanent saline prostheses, postoperatively adjustable saline prostheses, and both permanent and postoperatively adjustable silicone prostheses. Also available are implants with a silicone shell around a central saline core. Each variety has specific advantages and disadvantages. Silicone implants have a more natural texture when placed on the chest wall, but they have been shown to have significantly higher rates of postoperative capsular contracture. Additionally, despite copious evidence to the contrary, certain elements of the public are still concerned about the risk for systemic illness as a result of silicone breast implants. Saline implants are less natural feeling to the touch and are more prone to wrinkling, which may be visible as rugae beneath the skin.

f0180 **Figure 12.13-1**   Right-sided implant based reconstruction after mastectomy. Left-sided deep inferior epigastric perforator flap–based reconstruction after mastectomy.
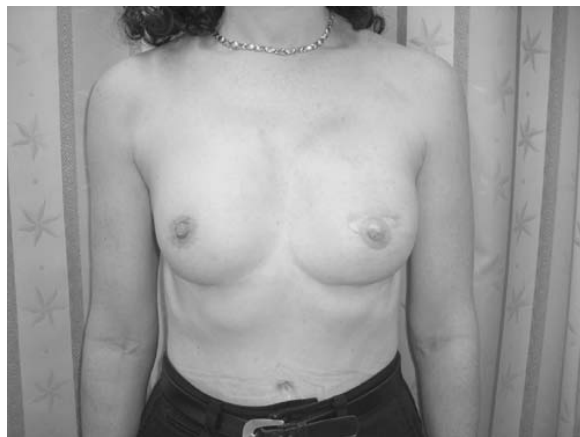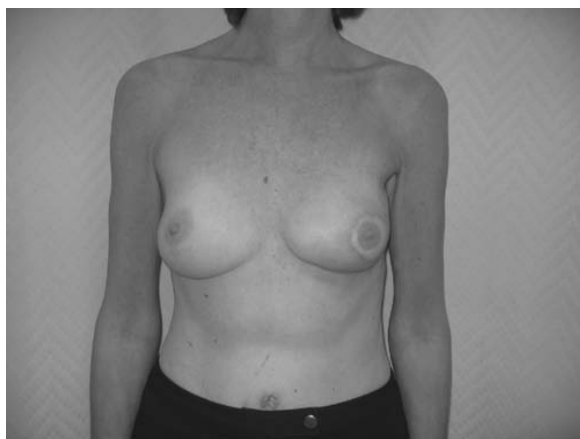

Figure 12.13-3   Left implant reconstruction.   f0200

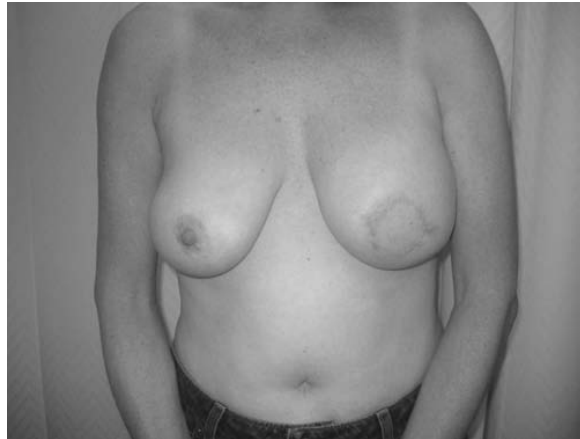f0190 **Figure 12.13-2**   Left-sided deep inferior epigastric perforator flap.

Figure 12.13-4   Left latissimus flap reconstruction with implant.   f0200
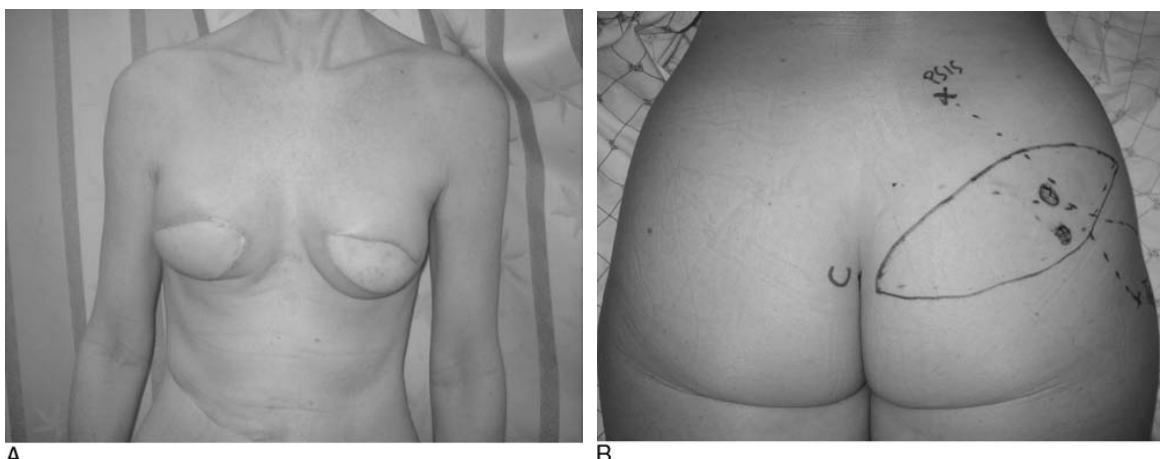
A   B

Figure 12.13-5 Bilateral superior gluteal artery flap reconstruction and buttock markings.   f0200

p3110   All implants have a significant risk of rupture—approximately 1% per year—and it is generally believed that 50% rupture by 10 years. Other risks include implant migration and "bottoming out," capsular contracture (as previously mentioned), infection, and (rarely) extrusion. Patients who have undergone or will undergo radiation therapy are much more likely to experience complications from breast implants compared with nonirradiated women. Patients must understand that as a result of these complications, most implants require reoperation for adjustment or replacement with time.

p3120   In general, implant reconstruction is the quickest type of reconstruction available in terms of length of operation. Most postmastectomy implants are placed subpectorally because the alternative subglandular method is not an option when the breast gland has been removed. Following mastectomy, the pectoralis major is dissected free from the chest wall along its inferior border. The subpectoral plane is then dissected, leaving intact the superior attachments and varying portions of the medial and lateral attachments on the basis of implant size. Because of the larger size implants that are often required to attempt to match the contralateral breast (rather than the relatively smaller implants that are used in purely cosmetic procedures to augment the preexisting breast tissue), a significant portion of the implant is often exposed without pectoralis major coverage. To increase the strength of tissue between the skin and the implant and to better support the implant along the IMF, acellular dermal matrices may be used to create a sling between the IMF and the detached inferior pectoralis muscle—the most common used being Alloderm (LifeCell, Branchburg, NJ).

p3130   Patients who have insufficient existing skin, either as a result of tumor biology requiring larger skin resection or because of skin contraction associated with delayed reconstructions, require tissue expansion. Adjustable implants incorporate a port for infusion of volume following surgery. Patients usually receive tissue expansion in the outpatient office weekly for 6 to 8 weeks. Some ports may remain permanently, whereas others should be removed as a separate procedure, often performed under local anesthesia. These devices provide an alternative to the more traditional method of temporary tissue expander placement followed by a second surgery through the mastectomy incision to replace the expander with a permanent implant.

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AUTOLOGOUS RECONSTRUCTION

p3140 Breast reconstruction may also be accomplished with autologous tissue harvested from another region of the patient's body. The most widely used donor site is the abdomen. Current techniques include the pedicled transverse rectus abdominis myocutaneous (TRAM) flap, free TRAM flap, free deep inferior epigastric perforator (DIEP) fasiocutaneous flap, and free superficial inferior epigastric artery (SIEA) fasiocutaneous flap. When patients are not candidates for harvest from the abdomen because of insufficient tissue or prior abdominal procedures that may have eliminated necessary collateral blood supply, the latissimus dorsi muscle from the back can be used as pedicled or free tissue transfer. A further modification allows the thoracodorsal artery and vein perforators to be used to carry the soft tissues of the back while leaving the latissimus muscle intact and functional (TDAP flap). The skin and fat from the superior gluteal area can be harvested as a free tissue transfer from a perforating branch of the superior gluteal artery (SGAP Au66 flap).

The most basic distinction between types of autologous reconstruction is the use of pedicled versus free tissue transfer. Pedicled flaps require maintenance of the existing blood supply to the tissue that is transferred to the breast. This is accomplished by sacrificing the collateral, supplemental blood supply to the tissue while elevating a significant portion of the tissue mass. This is then shifted or rotated to the breast, but the tissue surrounding the remaining blood supply is left intact. Free tissue transfer is a more technically challenging procedure requiring (in addition to harvest of the donor tissue as in a pedicled procedure) isolation of the dominant blood supply to the donor tissue, dissection of these vessels for some distance along their course, division of the vessels, and reanastomosis under loupe or operating microscope magnification to recipient vessels in the breast pocket, which must also be located and dissected free from surrounding tissue. p3150

Before the widespread use of microsurgery, the pedicled TRAM p3160 procedure was the autologous reconstruction of choice in breast surgery. This method requires a low transverse abdominal incision similar to that of an abdominoplasty, which is used to harvest abdominal skin and underlying subcutaneous tissue of sufficient volume to reconstruct the breast. The anterior rectus sheath is harvested, as is the majority of the rectus abdominis muscle. The deep inferior epigastric vessels are identified and sacrificed, and the rectus muscle is dissected free from its posterior sheath (or peritoneum below the arcuate line). The muscle serves as a conduit to protect the perforating vessels from the superior epigastric vessels that supply the skin and fat that are crucial to the breast reconstruction. This tissue must then be tunneled under the upper abdominal skin and subcutaneous fat and into the breast pocket, necessitating extensive undermining of the skin and fat of the entire anterior

abdominal wall. This undermined tissue is then advanced inferiorly to allow closure of the abdominal defect, with relocation of the umbilicus as in a cosmetic abdominoplasty.

p3170   The pedicled TRAM procedure is acceptable for bilateral reconstructions but it may also be used for unilateral reconstructions. For unilateral procedures, tissue from either the contralateral or ipsilateral side may be used to recreate the breast. Use of contralateral tissue leaves a postoperative midline substernal bulge because of the bulk of the tissue protecting the blood supply, whereas ipsilateral tissue use effaces the inframammary fold in smaller-breasted women, again because of the bulk of the tissue around the pedicle. In addition to the suboptimal contour irregularities associated with the pedicled TRAM, it can be difficult to achieve final symmetry using this technique. Intraoperatively, the rectus abdominis muscles accounts for a significant portion of the bulk of the newly reconstructed breast. With time, however, this muscle will atrophy because of denervation, leaving a smaller breast. The amount of atrophy, and hence the final appearance of the reconstruction, can be difficult to estimate intraoperatively.

p3180   Certain patients are not ideal candidates for the pedicled TRAM procedure. Diabetic patients, smokers, and obese patients with extremely thick subcutaneous fat layers may experience more fat necrosis of both the breast flap and the extensively undermined areas of the abdomen. This results from insufficient blood supply to support the quantity of adipose tissue transferred and can lead to areas of wound breakdown and increased scarring, hardness that may mimic cancer recurrence and decrease the adequacy of the texture of the reconstruction, and contour irregularities that are aesthetically displeasing.

p3190   Patients who require a more robust blood supply to the reconstructed breast tissue are more appropriate candidates for free tissue transfer. The free TRAM procedure, similar to the pedicled TRAM, requires harvest of a significant portion of the rectus muscle and its fascia to protect the perforating branches of the blood vessels that supply the overlying skin and fat. However, in direct contrast to the pedicled TRAM reconstruction, free tissue transfer usually sacrifices the superior epigastric vessels, making the tissue dependent on the deep inferior epigastric vessels, which are isolated and dissected for a distance proximally along their course.

p3200   After these vessels have been adequately dissected, they must be divided and reconnected to recipient vessels in the chest. Axillary vessels such as the thoracodorsals or thoracoacromials, internal mammary perforators, and the internal mammary vessels themselves (ipsilateral or contralateral, following rib resection) are all possible candidates. These vessels, too, must be meticulously identified and dissected free from their surroundings to facilitate microscopic anastomosis.

p3210   In an effort to minimize morbidity associated with the procedure, most free TRAM procedures are now performed with minimal amounts of harvested muscle. Despite repair or reconstruction of the anterior rectus sheath following either pedicled or free TRAM harvest, studies have shown postoperative abdominal bulges in this area that are displeasing to the patients. Authors have also reported significantly decreased functionality of the abdominal wall following harvest of the majority of, or even a limited portion of, rectus abdominis muscle. Other authors feel that the functional limitations following rectus harvest are limited to specific activities such as performance of sit-ups, which may be considered superfluous in the majority of the target population. [Au67]

p3220   Because the abdominal wall morbidity of the TRAM procedure can be considered significant, the use of the free DIEP flap has recently been on the rise. This procedure is more technically challenging than the free TRAM. It requires identification of a dominant deep inferior epigastric perforator artery and vein as they pierce the anterior rectus sheath and enter the subcutaneous fat of the abdominal wall. After an appropriate candidate perforator bundle has been identified, these vessels must be dissected free from the surrounding rectus muscle along their entire course until they meet the deep inferior epigastric vessels, increasing the risk of injury to the vessels during the procedure. This procedure allows for preservation of the entire rectus muscle and its sheath, thereby minimizing abdominal wall complications. To facilitate identification of these perforators, some centers use Doppler or three-dimensional computed tomography angiograms to preoperatively map perforators.

p3230   The free SIEA flap is another alternative reconstructive technique aimed at avoiding damage to the abdominal wall. This procedure depends on identification of the superficial inferior epigastric artery and vein within the subcutaneous tissue of the abdominal wall. As with the other free tissue transfers, these vessels are then freed along their course, harvested with the fat and skin they supply, and anastamosed to recipient vessels in the chest. However, these vessels are found to be missing or of inadequate size in more than half of patients, making this an unreliable initial reconstructive plan.

p3240   As previously mentioned, women who have no abdominal pannus or who have had prior abdominoplasty procedures or extensive abdominal surgery with multiple abdominal wall scars are not candidates for autologous reconstruction using the abdomen. In these circumstances, the latissimus dorsi muscle and overlying skin and fat may be transferred as a pedicled or free flap based on the thoracodorsal artery and vein. Loss of this muscle is well tolerated and leads to minimal functional impairment. However, seromas are frequent at the donor site, and the tissue is often of insufficient bulk to create a breast of sufficient size, necessitating use of an implant in addition to the autologous tissue. A modification of the latissimus flap using perforator techniques developed in the abdominal harvest of DIEP flaps allows a thoracodorsal artery perforator to be dissected in continuity with the overlying skin and fat while sparing the entire latissimus muscle. The TDAP flap requires meticulous dissection but is applicable in those patients with higher shoulder-girdle demand, such as avid swimmers, golfers, and tennis players.

p3250   The skin and subcutaneous tissue overlying the superior gluteal region can also be harvested as a free tissue transfer from perforating branches of the superior gluteal artery and vein. Unfortunately, the harvest of these vessels is technically challenging. Additionally, the vessels are often short, sometimes necessitating vein grafts as conduits to provide sufficient length between the recipient chest vessels and the donor vessels arranged to provide optimal breast shape. [Au68]

p3260   Any free tissue transfer is an extremely complex procedure and carries significant risks, including total flap loss. Intraoperative anticoagulation and varying regimens of postoperative anticoagulation are aimed at preventing arterial and venous thrombosis. Either complication can lead to necrosis of the transferred tissue, thus intensive postoperative monitoring of the tissue and of the patient's fluid status and hemoglobin levels is necessary to minimize complications. If changes become evident in the flap, immediate return to the operating room may salvage the tissue in certain circumstances, but not all. Given the complexity of the technique, longer operating times are required, and frequent use of the internal mammary vessels prevents later cardiac revascularization with these vessels. Therefore free tissue transfer is not always considered a viable option in the older or sicker mastectomy patients.

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SECONDARY PROCEDURES

p3270   Following reconstruction of the volume of the affected breast, women often undergo reconstruction of the nipple approximately 6 weeks postoperatively. This may be accomplished with myriad local flaps designed to create a small projection and is often performed under local anesthesia. Small adjustments to the reconstructed breast, including axillary liposuction, scar revision, and dog-ear resection, can also be performed at this time. Tattooing of the areolar complex is usually performed in the outpatient setting 6 weeks after creation of the nipple papillae.

p3280   Symmetry can be difficult to achieve with even the best breast reconstruction if the native breast is extremely large or aged and ptotic. Contralateral mastopexy, reduction mammaplasty, or mastopexy with augmentation are all treatments that may be applied to the native breast to achieve symmetry. However, these procedures do lead to additional scarring. Rearrangement of the breast tissue or augmentation may also be a concern to patients who are considering cancer surveillance. Reduction mammaplasty has not been shown to impair mammography, and special techniques are employed to perform mammograms on augmented breasts. However, areas of scarring or fat necrosis may be evident on mammograms and necessitate biopsies and further workup.

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CONCLUSIONS

p3290 Given the large numbers of women affected by breast cancer, breast reconstruction is a frequently performed procedure for which there will likely be increased demand with time. Many studies have shown that women benefit physically and psychologically when given the option to undergo breast reconstruction following mastectomy. There is currently a wealth of techniques available to the reconstructive surgeon, but new frontiers remain to be explored to optimize the form and function of the reconstructed breast.

Suggested Reading

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