Breast Reconstruction with Implants and Expanders

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Learning Objectives: After studying this article, the participant should be able to: 1. Assess the suitability of a patient for prosthetic reconstruction. 2. Understand the principles of dimensional planning for implant and expander selection. 3. Discuss the advantages and disadvantages of immediate versus delayed expander/implant reconstruction. 4. Apply the surgical techniques of immediate and delayed expander/implant reconstruction.

Breast reconstruction with expanders and implants provides an excellent option in the properly selected patient. Techniques for reconstruction have evolved significantly over the past 30 years with the development of more sophisticated devices and improvement in surgical procedures. Several options exist, each with its own advantages and disadvantages. Two-stage breast reconstruction using a textured device with an anatomic shape and integrated valve seems to provide the most consistent and reproducible results in most patients. Those patients with small, minimally ptotic breasts may be candidates for either single-stage implant reconstruction or reconstruction with an adjustable device. Advantages of expander and implant reconstruction over other techniques include relative ease of the procedure; no distant donor-site morbidity; use of tissue of similar color, texture, and sensation; reduced operative time; and more rapid postoperative recovery. (Plast. Reconstr. Surg. 107: 177, 2001.)

Modern breast reconstruction was launched in the 1960s with the introduction of the silicone breast implant. While autologous tissue reconstruction using a transverse rectus abdominis musculocutaneous (TRAM) flap is the gold standard for breast reconstruction today, there are still many cases in which an expander and/or implant provides another reasonable option. The modern era of breast reconstruction using tissue expansion was pioneered by Radovan1 in the late 1970s and early 1980s. Since that time, great strides have been made, not only in the technique of expander/implant breast reconstruction but also in the devices themselves. Anatomic expanders provide a more natural shape to the reconstructed breast by allowing preferential expansion of the lower pole. Textured expanders have allowed for more complete expansion by decreasing the amount of capsular contracture and by creating expansion in the desired location without expander migration.2 Maxwell and Falcone,3 in a series of 84 consecutive patients who underwent expander/implant reconstruction using textured devices with integrated valves, reported a capsular contracture rate, defined as Baker class III or IV, of 3 percent and a lower incidence of infection than seen with remote port devices. These conclusions were supported by Spear and Majidian,4 who reported a series of 171 consecutive breast reconstructions using textured devices with integrated valves with a capsular contraction rate of 3 percent, an infection rate of 1.2 percent, a spontaneous deflation rate of 0.6 percent, a 1.8 percent overall deflation rate, and no valve dysfunctions. The low incidence of deflation is attributable in part to careful technique and to confirmation that the valve is easily accessed through the skin before the patient leaves the operating room. This ensures accurate needle placement with subsequent expansions in the office. This low rate of expander deflation compares favorably with previously published implant deflation rates, which is also a reflection that most expanders are electively replaced in less than 1 year. In contrast, Francel et al.5 reported capsular contracture rates of 8 to 15 percent using smooth-surface implants and expanders. Slavin and Colen6 described a series of 60 consecutive breast recon-
structions using devices with remote ports and reported an incidence of valvular dysfunction of 5 percent, an infection rate of 6.7 percent, and a 5 percent incidence of deflation. Potential advantages of expander/implant reconstruction over other techniques include (1) relative simplicity of the surgical procedure, (2) use of adjacent tissue of similar color, texture, and sensation, (3) elimination of distant donor-site morbidity, (4) minimal incisional scarring, and (5) reduced operative time and postoperative recovery. Several options exist for breast reconstruction using expanders and implants. These include single-stage reconstruction, both immediate and delayed, with either a standard implant or an adjustable implant, or either immediate or delayed two-stage reconstruction with an expander, which is then replaced with a “permanent” implant. In general, the incidence of complications is higher in immediate reconstruction using implants/expanders, with higher rates of seroma formation, skin necrosis, implant exposure/extrusion, valve malfunction, and leakage/deflation being reported.

GENERAL CONSIDERATIONS

Nearly any patient who has undergone mastectomy is a candidate for some form of expander/implant reconstruction; however, the best results are in patients in which the breast volume is moderate (500 g or less), there is no or minimal ptosis, and there is sufficient healthy soft-tissue coverage. Patients with large or markedly ptotic breasts will probably require some type of matching procedure to obtain satisfactory results with prosthetic reconstruction. Situations of delayed reconstruction or immediate reconstruction with short healthy flaps normally provide adequate coverage for expander/implant reconstruction. Patients who have undergone or will undergo radiation therapy as part of the treatment of their disease are generally not good candidates for expander/implant reconstruction alone and will probably require some type of flap procedure with or without an implant/expander. Not only is expansion difficult in the radiated patient, but the risks of capsular contracture, implant exposure, infection, and rib fracture are increased. In immediate reconstruction, preoperative planning and a good working relationship with the general surgeon are the keys to a successful outcome. It is therefore imperative that the plastic surgeon work closely with the general surgeon, beginning with the preoperative evaluation, marking the proposed incision lines, ensuring healthy flaps, preservation of the inframammary fold, protection of the pectoralis major and serratus anterior muscles, and the coordination of postoperative care.

SINGLE-STAGE BREAST RECONSTRUCTION: IMMEDIATE

Patient Selection

Immediate single-stage breast reconstruction with an implant is best suited to the patient with small, round breasts and minimal if any glandular ptosis. Breast size is typically A or small B cup with an estimated weight less than 300 g. Patients who have mild ptosis of the opposite breast and desire a minimalist approach to reconstruction can also be candidates as long as they understand that the reconstructed breast might not ideally match the opposite side. More severe ptosis of the opposite breast will require a mastopexy to achieve

Fig. 1. A 40-year-old woman with previous breast augmentation and biopsy-proven cancer of the left breast. (Left) Preoperative appearance; the biopsy scar is evident on the medial aspect of the left breast. (Right) Seven months after mastectomy, placement of a 500-cc, round, double-lumen silicone gel implant, and nipple and areolar reconstruction.
symmetry. This technique could also be appropriate for the occasional patient with a larger breast, particularly if she has had a previous subpectoral augmentation (Fig. 1).

**Technique**

The success of the procedure is largely determined before the patient enters the operating room and begins with preoperative marking and implant selection. The key landmark for any breast reconstruction is the inframammary fold. This mark should be placed precisely at the level of the old fold in cases in which there is no ptosis of the opposite breast and can be adjusted up to 2 cm inferiorly if the opposite breast is mildly ptotic. Although this maneuver might create some asymmetry of the inframammary folds, it is better to have a fold that is too low on the reconstructed side rather than too high. Some degree of mild fold asymmetry is a normal finding in the unreconstructed population. Ptosis of greater than 2 cm usually requires a matching procedure.

The critical measurement to consider when selecting an implant is the base diameter of the breast. This is best obtained preoperatively using a combination of calipers and a template of the implant placed over the breast. Other factors to consider are the height and projection of the breast, both of which can be measured, and the volume of the breast, which is estimated preoperatively and obtained directly from the weight of the mastectomy specimen intraoperatively (Fig. 2). In general, the weight of the mastectomy specimen in grams is a useful piece of information in choosing the volume of the implant in cubic centimeters. A round implant is best used in a patient with flat, round breasts and no ptosis. A patient with some fullness to the lower breast and minimal ptosis is best reconstructed with an anatomic implant.10

All patients receive perioperative antibiotics, and the procedure itself begins with both breasts being widely draped in the mastectomy field. The arms are placed at the patient’s sides with the hands padded and tucked beneath each hip. If an axillary dissection is to be performed, the ipsilateral arm is draped in the field according to the wishes of the general surgeon, typically covered with a sterile stockinette and placed on an armboard. At the conclusion of the mastectomy, the arm is placed at the patient’s side, a towel clip is used to secure the stockinette to the drapes, and the armboard is removed. The entire field is redraped over the previous drapes, and a separate set of sterile instruments is used, including cautery and suction. The mastectomy site is inspected, hemostasis is ensured, and the viability of the soft tissue, especially the skin, is checked. Obviously nonviable tissue is excised, and tissue of questionable viability can be assessed using fluorescein. If there is any doubt as to the adequacy of soft-tissue coverage, the wound should be closed and the reconstruction delayed. If all looks well, a submuscular pocket is then created. This can simply be subpectoral if no axillary dissection has been performed or can include the serratus anterior to prevent lateral displacement of the implant if an axillary dissection has been done. The pocket is created by first identifying the lateral edge of the pectoralis major muscle and elevating it using electrocautery. The inferior 2 to 3 cm of its medial origin may be released from the sternum as needed to allow the lower portion of the implant to lay in the subcutaneous space (Figs. 3 and 4). This provides better projection to the lower one-third of the breast and causes less

**Fig. 2.** Calipers provide an easy and accurate means of measuring the breast. These measurements of width, height, and projection in conjunction with a volume estimate can be compared with the specifications of available devices and greatly facilitate selection of the correct expander or implant. [From Spear, S. L. (Ed.). Surgery of the Breast: Principles and Art, 1st Ed. Philadelphia: Lippincott-Raven, 1998. Used with permission.]
distortion of the implant with muscular contraction (Fig. 5). If the serratus anterior muscle is to be used for coverage of the implant, the dissection is performed one rib at a time using electrocautery over the fourth, fifth, and sixth ribs. If a patient has a small opposite breast with no ptosis or there is concern about the skin flaps, the implant can be placed in a totally submuscular position by including the superior portion of the rectus abdominis fascia or muscle in the dissection of the muscular pocket. At this point the inframammary fold can be adjusted as needed and the pocket refined. If the lower portion of the implant is placed subcutaneously, it is wise to secure the inferior edge of the pectoralis major muscle in an anatomic position because both the superficial and deep attachments as well as a portion
of its medial origin will have been divided during the dissection. This is accomplished by the placement of several U stitches of 2-0 polydioxanone suture through the skin, through the inferior edge of the muscle, and back out the skin below the mastectomy incision but above the inframammary fold (Fig. 6). These “marionette” sutures are placed in hemostats and are tied loosely after the incision is closed. The implant is then placed in the pocket with its inferior edge at the level of the inframammary fold, and if the serratus muscle has been dissected, a running 3-0 polydioxanone suture is used to approximate its free edge to the lateral edge of the pectoralis major muscle. One or two suction drains are placed, one in the submuscular space and one beneath the skin flaps, depending on what dissection was done. The skin is closed in two layers using 3-0 Monocryl for both inverted dermal sutures and a running subcuticular suture. Gentle traction is then placed on the marionette sutures, drawing the lower edge of the pectoralis major muscle inferiorly. These sutures are then tied loosely, allowing approximately 1 cm between the knot and the skin (Fig. 7). This maneuver ensures muscle coverage of the implant beneath the mastectomy incision. Tegaderm is placed on the skin below the marionette sutures, tension is applied, and a second Tegaderm is placed over the sutures. The sutures are then drawn superiorly and a third Tegaderm placed over them. This prevents the sutures from retracting and injuring the skin and secures the muscle in position. The incision itself is dressed with an additional Tegaderm, which allows observation of the wound without multiple dressing changes.

Frequent follow-up over the first 14 days is mandatory, and any areas of full-thickness skin loss are excised and the edges reapproximated.
in the office. Patients are kept on antibiotics for 7 days postoperatively. The marionette sutures are removed on or near postoperative day 10 and the drains removed when the output is less than 30 cc in 24 hours. When the drain output persists greater than 30 cc per 24 hours beyond 14 days, the drain is removed regardless of the output. This may result in a seroma, but this almost always resolves spontaneously with time.

**Single-Stage Breast Reconstruction: Delayed**

Patient selection criteria are identical to those used for immediate single-stage breast reconstruction. Measurements for implant selection are the same and are based on the remaining breast as are the marking of the proposed pocket and the inframammary fold. Again, the fold can be adjusted inferiorly up to 2 cm to compensate for minimal ptosis. Delayed reconstruction offers some advantages over immediate reconstruction. It is technically easier because it involves less dissection, and there should be no question as to the viability of the flaps. The procedure itself is similar to immediate reconstruction but varies on several points. The incision is made at the site of the previous mastectomy scar, which can be partially or totally excised when needed. The dissection proceeds through the subcutaneous fat and the pectoralis major muscle. In patients with thinner skin flaps, cutting directly through the muscle is safer because it leaves a portion of it superior and inferior to the inci-
sion. This ensures good muscle coverage of the implant when the wound is closed. When the inferior edge of the pectoralis major muscle is encountered, dissection continues in the subcutaneous plane to the level of the inframammary fold, and the inferior 2 to 3 cm of the sternal origin of the muscle can be released as needed. Again, this allows for improved fullness of the lower portion of the breast as compared with total muscle coverage. The superior portion of the dissection is subpectoral and extends to the skin markings for the pocket. In the context of delayed reconstruction, there is no need for serratus anterior muscle dissection or marionette sutures. A suction drain is placed and the wound closed in layers in the same manner described for immediate reconstruction using 3-0 polydioxanone suture to approximate the pectoralis major muscle and 3-0 Monocryl for the dermis. Postoperative care and follow-up are the same.

ADJUSTABLE IMPLANT BREAST RECONSTRUCTION

Selection criteria for adjustable implant breast reconstruction are the same as for single-stage reconstruction and it is the preferred technique when the ability to adjust the volume of the device postoperatively is especially desirable (Fig. 8). Situations in which this versatility may be beneficial include either immediate or delayed reconstruction of the small-breasted woman where there is a noticeable deficiency of skin. The implant can be partially inflated at the time of reconstruction and gradually inflated to the desired volume. In patients with small, mildly ptotic breasts, the device can be over inflated initially, with deflation 3 to 6 months later to the ideal volume to achieve better symmetry.11 The technique for placement of the implant is the same as previously outlined; however, placement of the remote port and the need for its subsequent removal must be considered. The valve may be placed inferior to the inframammary fold along the lateral chest, or elsewhere as long as it is safely away from the implant to avoid implant puncture during later fill procedures (Fig. 9). Removal might require a separate incision, which is best placed over the tube connector rather than the dome itself to facilitate the dissection of the proximal and distal portions of the tubing. Drawbacks to using this device include superficial infection or discomfort, which are sometimes associated with the port; valve dysfunction, which occurs more frequently with these remote port devices; and a second procedure, which is needed to remove the port, often with an associated additional incision and scar.

TWO-STAGE RECONSTRUCTION: IMMEDIATE

Two-stage reconstruction using an expander is especially desirable when there is insufficient tissue after mastectomy or when the desired size and shape of the breast cannot be safely and consistently achieved with a single-stage procedure.
**Patient Selection**

Nearly any patient who undergoes mastectomy can be a candidate for expander and implant reconstruction. As with single-stage reconstruction, smaller breasts without significant ptosis are more easily reconstructed. However, expansion, the use of anatomic implants, and adjustments to the pocket at the time of the second procedure allow more consistent reconstruction of the moderately sized breast with mild ptosis. Prosthetic reconstruction in patients with large breasts and/or significant ptosis require contralateral reduction or mastopexy. As previously stated, preoperative or postoperative radiation is a relative contraindication to isolated implant reconstruction.

**Technique**

The procedure for expander placement varies little from that described for single-stage reconstruction. Marking is the same, with the inframammary fold being the most important landmark. If a matching procedure is necessary, appropriate marking of the opposite breast performed and the procedure carried out at the time of expander placement. This allows the final shape of the remaining breast to be determined initially and provides a guide for tissue expansion and final implant selection. At the time of implant placement, additional adjustments can be made to the remaining breast to achieve symmetry. Expander selection is based on the patient’s anatomy and the opposite breast. We believe textured anatomic expanders with integrated valves have been shown to work best. These have fewer problems with capsular contracture and valve dysfunction and allow preferential expansion of the lower pole of the breast where it is needed. A potential problem with an anatomic device is loss of proper orientation. This can be minimized by inferior capsulectomy, drain placement to avoid fluid accumulation, and placement of a binder above the breasts to maintain implant position. Base diameter, height, projection, and volume must all be taken into account when choosing the device. Once the appropriate dissection has been carried out, the expander is placed in the pocket, with care being taken to maintain proper orientation. The port is then accessed through the skin and the tubing is connected to a liter of normal saline placed in a pressure bag. Wound closure continues while the device fills,

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**Fig. 10.** A 53-year-old woman with a history of right breast cancer and excisional biopsy. 
(Above) Preoperative photograph showing the biopsy site and associated ecchymosis. 
(Center) The patient subsequently underwent mastectomy and placement of a McGhan style 133, 400-cc, textured anatomic tissue expander with an integrated valve. Total fill volume was 240 cc. 
(Below) Appearance after placement of McGhan style 363, 310-cc anatomic implant, nipple and areolar reconstruction, and left mastopexy.
typically with 300 to 500 cc. Additional expansion postoperatively begins 2 to 4 weeks later, instilling 100-cc increments every 2 to 3 weeks. The frequency and amounts of expansion can be adjusted based on how well the patient tolerates the procedure. The amount of expansion is based on the opposite breast as well as the mastectomy specimen, with 0 to 25 percent overexpansion being the rule. If the patient is to undergo radiation therapy, expansion should be completed before radiation treatment. If the patient is to have chemotherapy, the exchange procedure should be delayed until after the treatment is completed and the laboratory values return to normal. Selection of the implant is based on the same parameters as those used for expander selection (i.e., base diameter, height, projection of the opposite breast, and the weight of the mastectomy specimen). Using these, an anatomic implant of appropriate size and shape is chosen. In virtually all cases, when an anatomic expander has been used, an anatomic implant is selected. Round saline implants tend to create a breast with inadequate projection, upper pole rippling, and too much upper pole height. We rarely use round saline implants except in some bilateral cases or in women with flat, round breasts, as are seen in some Asian women. The patient is marked preoperatively with special attention paid to the final position of the inframammary fold and the dimensions of the pocket. Marking for nipple reconstruction is also done at this time if its position can

FIG. 11. A 31-year-old woman with a strong family history of breast cancer, including her mother, who also had ovarian cancer. (Above, left) Photograph taken before bilateral prophylactic subcutaneous mastectomies. (Above, right) Postoperative photograph after first-stage reconstruction with McGhan style 133, 400-cc, textured anatomic expanders with an integrated valve. Total fill volume was approximately 550 cc each. (Below) Final result after exchange to McGhan style 468, 380-cc, textured anatomic implants.
be confidently determined. The mastectomy scar is excised partially or totally and the dissection carried through the pectoralis muscle to the underlying expander. A portion of the muscle is left superior and inferior to the incision to ensure good muscle coverage of the implant. The pocket and inframammary fold are adjusted as necessary, and a capsulectomy below the inferior edge of the pectoralis major muscle is often performed to help improve fold definition. Additional capsulectomies or capsulotomies are done when needed. It is sometimes helpful to leave a rim of capsule at the edges of the incision to aid in closure, particularly when the flaps are thin. The implant is placed in the pocket, the skin edges are loosely approximated using staples, and the patient is placed in an upright sitting position to check for symmetry and the proposed nipple position. Adjustments are made as needed, including the opposite breast. A suction drain is placed, and after the wound is closed, the nipple is reconstructed. The patient is placed in a support bra and binder above the breasts for 10 to 14 days to keep the anatomic implant properly oriented (Figs. 10 and 11).

**TWO-STAGE RECONSTRUCTION: DELAYED**

Patient selection and technique are essentially the same as for two-stage immediate reconstruction; however, a period of 3 to 6 months should elapse between mastectomy and reconstruction to allow the wound to mature and to complete any adjuvant therapy (Fig. 12).

**DISCUSSION**

Breast reconstruction using expanders/implants provides an excellent option for properly selected patients. In general, patients with small, minimally ptotic breasts are the best candidates for implant reconstruction alone, whereas patients with larger, more ptotic breasts might require a matching procedure to attain symmetry. The matching procedure can be a simple mastopexy or can involve a breast reduction. Potential advantages over other reconstructive techniques include the relative simplicity of the procedure; use of adjacent tissue of similar color, texture, and sensation; no donor-site morbidity; and reduced operative time and recovery. Newer textured devices with integrated valves and an anatomic shape seem to provide more consistent and predictable results with fewer complications.

**Fig. 12.** A 69-year-old woman with a history of right breast cancer, right modified radical mastectomy, and prophylactic left simple mastectomy. (Above) Appearance 5 years after mastectomies. (Center) Appearance after first-stage reconstruction using McGhan style 133, 500-cc textured anatomic tissue expanders with integrated valves. Total fill volume was 340 cc. (Below) Final result after exchange to McGhan style 168, 375-cc textured anatomic implants and nipple and areolar reconstruction.
there is little question about the viability of the flaps after the mastectomy. Advantages of this approach include ease of dissection and fewer surgical procedures. Delayed reconstruction is a safer option, with fewer complications being reported when compared with immediate reconstruction; however, it does require a postponement of the reconstruction, which also has disadvantages, both surgical and psychological. Success depends on careful preoperative planning, coordination with the oncology surgeon in cases of immediate reconstruction, and meticulous postoperative follow-up. Ultimately, the final result depends on a number of factors. Women with smaller or medium-sized breasts with minimal skin loss and reasonably thick and uniform skin flaps will do best.

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REFERENCES

Self-Assessment Examination follows on page 188.
1. WHICH OF THE FOLLOWING IS A RELATIVE CONTRAINDICATION TO BREAST RECONSTRUCTION WITH EXPANDERS/IMPLANTS?
   A) Radiation therapy to the mastectomy site
   B) Previous subcutaneous mastectomy
   C) Failed previous expander reconstruction
   D) Bilateral mastectomies

2. WHICH OF THE FOLLOWING IS A POTENTIAL ADVANTAGE OF AUTOLOGOUS BREAST RECONSTRUCTION OVER EXPANDER/IMPLANT TECHNIQUES?
   A) Ease and speed of surgical procedure
   B) Less donor-site morbidity
   C) Use of tissue of similar color, texture, and feel
   D) Unlimited amounts of available tissue

3. THE KEY LANDMARK FOR BREAST RECONSTRUCTION IS
   A) The medial border of the breast
   B) The lateral border of the breast
   C) The inframammary fold
   D) The position of the nipple

4. ALL OF THE FOLLOWING ARE IMPORTANT MEASUREMENTS WHEN CHOOSING AN IMPLANT OR EXPANDER EXCEPT
   A) Base diameter of the breast
   B) Distance between the nipple and the suprasternal notch
   C) Projection of the breast
   D) Height of the breast

5. WHICH OF THE FOLLOWING PATIENTS IS BEST SUITED FOR SINGLE-STAGE BREAST RECONSTRUCTION USING A ROUND IMPLANT?
   A) A 20-year-old woman with B-cup breasts, second-degree ptosis, and an estimated volume of 400 g
   B) A 30-year-old woman with C-cup breasts, first-degree ptosis, and an estimated volume of 500 g
   C) A 25-year-old woman with A-cup breasts, no ptosis, and an estimated volume of 300 g
   D) A 35-year-old woman with D-cup breasts, third-degree ptosis, and an estimated volume of 600 g

To complete the examination for CME credit, turn to page 305 for instructions and the response form.