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Oncoplastic Breast Reconstruction: Patient Selection and Surgical Techniques

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Standard breast conserving techniques often fail to achieve the desired goal of tumor extirpation with adequate margins while preserving breast cosmesis. The emergence of oncoplastic breast reconstruction addresses these limitations and also allows breast conservation in women who would not have met traditional criteria. Using various volume displacing oncoplastic techniques, tumors can be successfully resected from any quadrant of the breast, while maintaining or improved breast cosmesis, diminishing post-radiation deformities, and providing breast symmetry.
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KEY WORDS: **oncoplastic; breast surgery; breast reconstruction; breast conservation; plastic surgery**

INTRODUCTION

The adoption of breast conserving therapy as an acceptable alternative to mastectomy opened the door to a wide and varied range of partial breast reconstruction techniques. The term oncoplastic breast surgery (OBS), as suggested by Werner Audretsch in 1993 [1], describes the concept of local tissue rearrangement that would allow for wide resections of tumors while preserving breast cosmesis. While the term has been used more broadly to include nipple-skin sparing mastectomies with immediate breast reconstruction, in this article, we limit the definition to immediate or delayed partial breast reconstruction with volume displacing or volume replacing techniques for patients receiving breast conserving treatment.

It is now appreciated that the goal of breast conservation should go beyond a successful excision with adequate margins. While it was once considered frivolous to be concerned with the cosmetic result following excision, the cosmetic result has now become important. The patient will live with this result for the rest of her life.

Many women have simple excisions and appear to have a reasonable cosmetic outcome in the early postoperative period. We now know that this may be misleading. The addition of scarring, resolution of seroma, and radiotherapy ultimately reveals the true aesthetic outcome many months later. The prevailing goal of oncoplastic breast surgery is to allow surgeons to widely excise tumors, minimizing the risk of involved margins, while simultaneously preventing the deformities commonly associated with simple excisions and post radiotherapy fibrosis.

Improved breast imaging and neoadjuvant chemotherapy allows a larger number of women to be considered for breast conservation. We must be prepared to offer OBS to women who may otherwise succumb to a mastectomy, simply to avoid the terrible post-lumpectomy deformities of the past.

GENERAL CONSIDERATIONS

Oncoplastic Team

Of utmost importance is a dedicated team approach. Breast surgeons, plastic surgeons, medical oncologists, radiologists, pathologists, radiation oncologists, and genetic counselors all help comprise a true multidisciplinary oncoplastic team. At our facility, the breast surgeon takes on the role of "leader" to guide the team and ensure communication amongst all members. During the first visit, we generate a "flight plan" that summarizes the diagnosis, includes pictures of the patient's chest and relevant imaging, and lists the plan of action leading up to and including the operation planned (Fig. 1). This flight plan is given to the patient, distributed to all team members, and updated as the patient moves through the consultation process.

Rationale for Oncoplastic Breast Surgery

A few of the factors implicated in poor cosmetic results after breast conservation are age >60, T2 or larger tumors, small breast size, re-excision for inadequate margins, improper scar orientation, breast tissue resection >100 cm^3 independent of breast size, breast ptosis, tumors located in the central, medial, or lower quadrants, and radiation dose inhomogeneity [2–6]. The common theme among all of these limitations is that the removal of tissue without proper reshaping of the breast allows scarring and post radiation fibrosis to reveal the un-reconstructed cavity, imbalance in breast tissue distribution, and distortion of the nipple-areola complex. These limiting factors are largely overcome when an oncoplastic reconstruction is performed. Oncoplastic breast conservation allows rebalancing of the breast. The breast is reconstructed with either a volume displacing technique or a volume replacing technique. This ability to maintain breast balance while reducing breast volume expands the pool of patients who could be

Conflict of interest: None.

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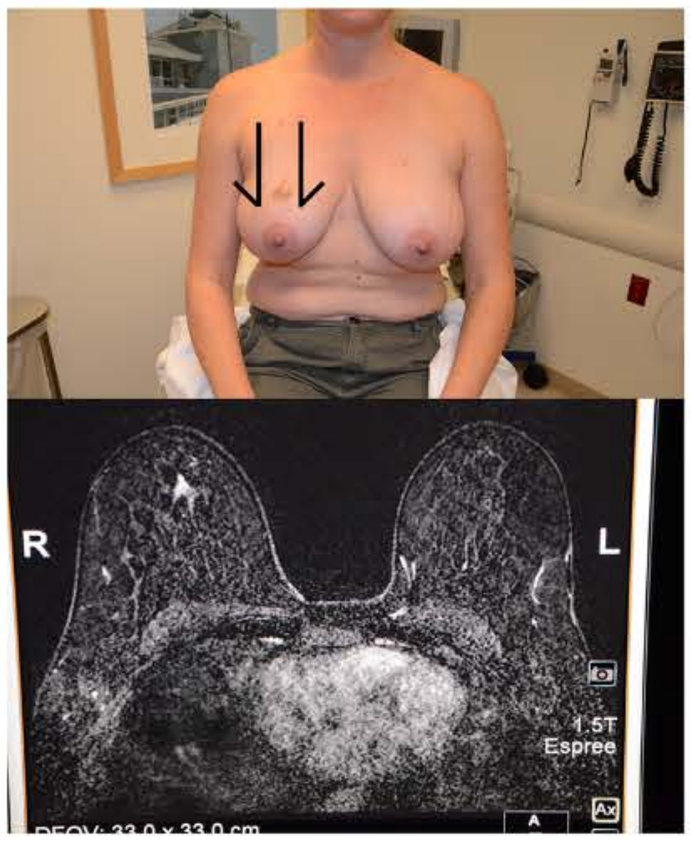
Patient Name
MR Number
Date

Diagnosis: RIGHT Grade II ductal carcinoma in situ, ER/PR Positive, 12:00 position, spanning 27 mm on MRI. 12 mm on mammo. 5 cm. from nipple



1. RIGHT wire guided segmental resection using split reduction
2. LEFT mastopexy for symmetry
3. Plastic surgical consultation with Dr Savalia
   949-759-0980
4. IORT Consultation
5. Genetic counseling

Melvin J. Silverstein, M.D.

Fig. 1. Flight plan.

considered candidates for breast conservation. This is of particular benefit to the patient with advanced disease who would need adjuvant radiotherapy regardless of mastectomy. These techniques are referred to as extreme oncoplasty or radical breast conservation [7,8].

The primary goal of breast conservation is to achieve local control with adequate margins while maintaining breast cosmesis [9]. Unfortunately, as many as 36% of simple excisions fail to achieve adequate margins in a single operation, leading to re-excision, worsening cosmesis, and conversions to mastectomy [10].

The benefits of breast conservation when compared with mastectomy are preservation of a sense of wholeness, retaining normal breast sensation, and limited morbidity from device based or autologous reconstruction. The benefits are even greater when adjuvant radiotherapy must be added to post-mastectomy reconstruction [11].

Reconstructive Goals

A common misconception is that the goal of breast reconstruction is to create the "perfect breast." In actuality, the goal should be to achieve an outcome that best suits the *patient's* goals for treatment and desires for final breast appearance. The patient's aesthetic goals are often tempered by the complexity of many of the most modern and technically state-of-the-art reconstructive methods. In the same vein, the default reconstructive goal should not be to simply maintain the patient's current appearance.

The reconstructive plan can be formulated only after analysis of the tumor size and location, the preoperative breast shape, size, and degree of ptosis, and understanding the patient's oncologic and reconstructive desires. The ideal is to minimize the amount of surgery, donor sites, recovery periods, risk of complications, and failure rates, while maximizing the desired aesthetic and oncologic outcome.

Many reconstructive options exist, ranging from a simple tissue rearrangement to a complex microvascular tissue flap reconstruction. Each step towards a more complex procedure must be carefully weighed against the patient's expectation of results and assessment of the risk to benefit ratio. The reconstructive surgeon may be tempted to utilize all of his/her advanced skills and create a complicated surgical plan with multiple surgeries. However, the patient may be satisfied with the reasonable breast shape and symmetry achieved with a simpler plan. The decision must be an amalgam of what is oncologically necessary and the simplest reconstructive plan that achieves the patient's goal. Our goal has always been to go to the operating room once, completing the oncologic and reconstructive portions of the case in a single procedure, if possible.

To help patients understand the value of OBS, they must be educated about their options. The conundrum becomes which patients merit a simple excision versus OBS. The answer becomes clear with understanding and predicting the post-lumpectomy deformity.

Women with smaller breasts (A/B cup) and minimal ptosis can be challenging. Simple excisions of small tumors are often believed to have little aesthetic impact. This is often true when the tumor is in the upper or upper outer breast, and a layered glandular repair is performed. However, even the smallest tumor can result in a post-lumpectomy deformity if excised from the lower pole of the breast. Post-operative scarring will deform the lower pole and retraction will displace the NAC inferiorly, resulting in the classic bird's beak deformity (Fig. 2). This can be avoided by recentralizing the NAC over the reshaped breast

Fig. 2. Bird's beak deformity after excision of a lower pole tumor from the left breast.

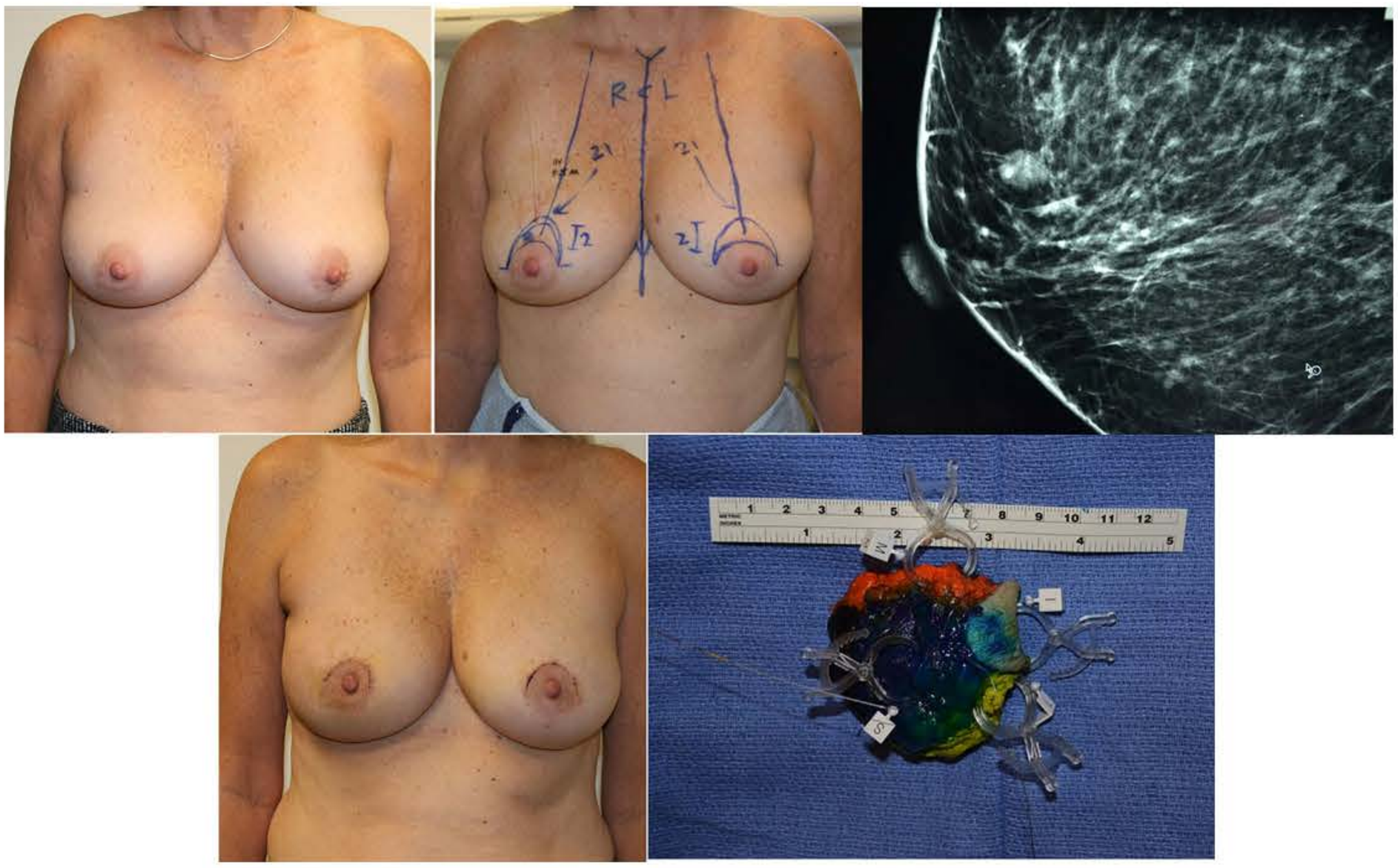


Fig. 3. Crescent Technique: 56-year-old female with an invasive ductal carcinoma of the right breast, spanning 7 mm on mammogram, at the 12:00 border of the areola. A crescent mastopexy allowed excision of a 44 g specimen with the skin margin. A contralateral crescent mastopexy provides symmetry. Final pathology revealed a 1.1 cm IDC and 5 cm of DCIS, with clear margins.

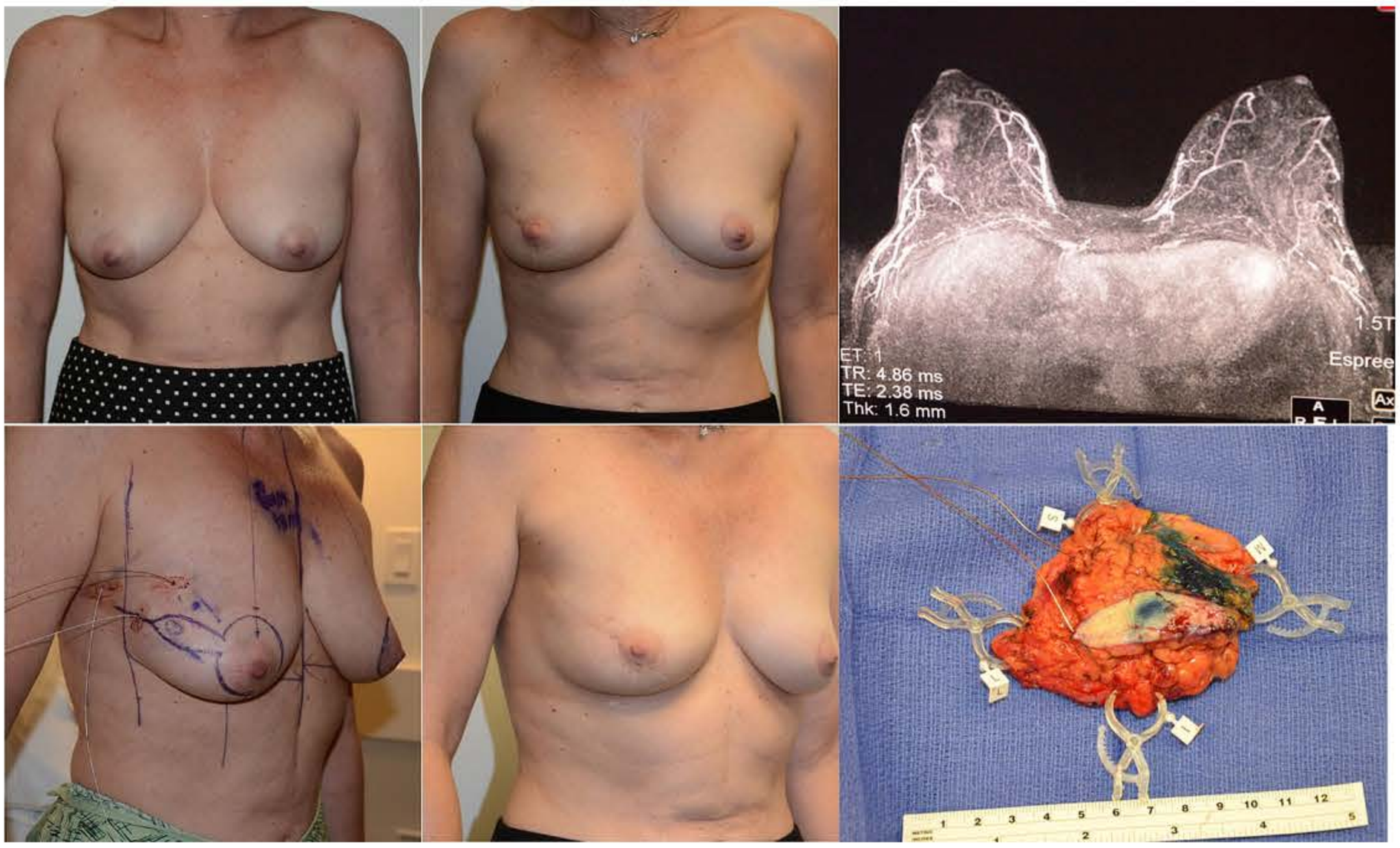


Fig. 4. Circumareolar Technique: 47-year-old female with an invasive ductal carcinoma of the right breast, at 10:00, spanning 25 mm on MRI. After neoadjuvant chemotherapy, a circumareolar/Benelli approach with a lateral skin ellipse over the tumor allowed excision of a 75 g specimen. Final pathology revealed a 1.4 cm invasive ductal carcinoma with clear margins, and 3/10 involved axillary lymph nodes. A contralateral circumareolar mastopexy provided symmetry. The postoperative photos are shown after adjuvant radiotherapy.

mound, immediately after the resection. With larger tumors, a prediction about the size of the defect will determine eligibility for breast conservation. If the predicted remaining breast is deemed adequate for reconstruction with glandular advancement or rotation flaps, then oncoplastic breast surgery can be planned. However, if these predictions are inaccurate, then a post lumpectomy deformity will result. In retrospect, these patients would have been better managed with volume replacement techniques or with skin-nipple sparing mastectomy. These missteps can only be avoided with experience, and the novice oncoplastic surgeon should be wary.

Women with larger breasts (C/D cup and beyond) and ptosis will benefit from oncoplastic breast surgery both oncologically and aesthetically. An oncoplastic approach will allow a larger excision with a higher probability of obtaining adequate margins as well as correction of breast ptosis and macromastia. Furthermore, the correction of macromastia yields the benefit of better adjuvant radiotherapy dose homogeneity with resultant long-term maintenance of cosmesis [12].

OVERVIEW OF CONCEPTS

Timing of Surgery

Index breast. Various options for timing of oncoplastic breast surgery have been suggested [13,14]:

- Immediate—definitive OBS at the time of tumor resection.
  Single stage approach that has the advantage of using surgically naïve tissue for reconstruction, but may require repeat surgery if margins are not clear, and may necessitate mastectomy if the proper margins cannot be identified at re-excision.
- Delayed-Immediate—delay OBS until final pathologic margins are confirmed to be clear, followed by OBS, usually 1–3 weeks later, prior to delivery of radiotherapy.
  Staged approach that has the advantage of definitively clearing the margins before committing to OBS.
- Delayed—no OBS until after completion of adjuvant chemo-radiotherapy, usually 1–2 years later.
  Has the advantage of minimizing potential delay of initiation of adjuvant therapy from wound healing complications, but has the highest complications rates and least favorable aesthetic outcome.

In our practice, we have evaluated our margin status for OBS after initial surgery, specifically comparing elliptical excisions versus wise pattern mammaplasty excisions. For tumors spanning $\leq$50 mm, the elliptical excision group had a tumor transection rate of 9% (n = 250) versus 3% (n = 300) for the reduction group [8]. For tumors spanning >50 mm in the extreme oncoplastic group, the tumor transection rate was 14% (n = 105) [8]. We feel justified in routinely performing immediate OBS in virtually all patients who are candidates for OBS. Even for tumors larger than 50 mm, the positive margin rate is at least equivalent to that of simple excisions with margin shaving [10]. In the case of positive margins, early re-excision, before scarring has obliterated the dissected planes, allows recreation of the excisional defect for more accurate re-excision. When conversion to

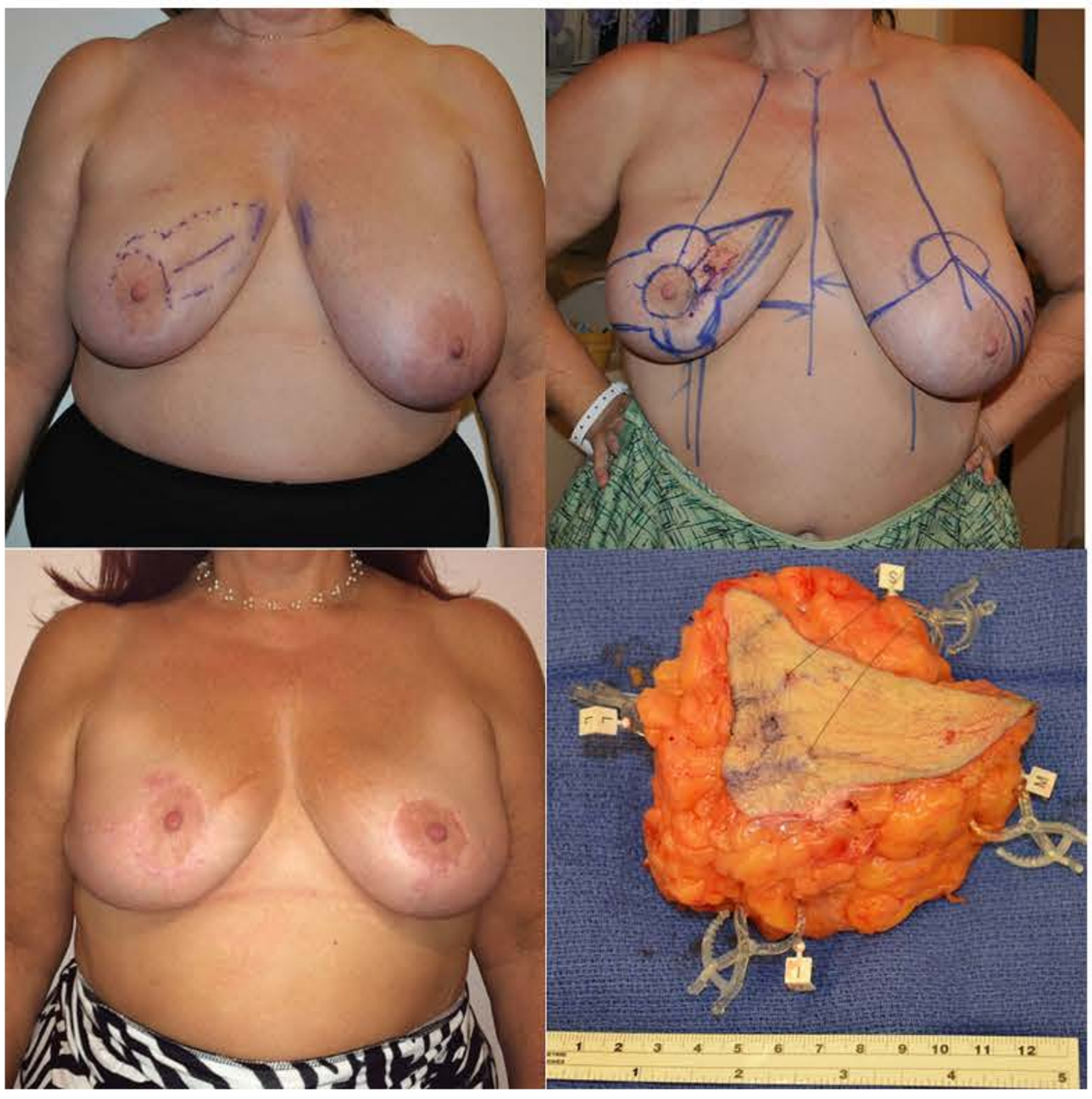


Fig. 5. Clamshell Technique: 60-year-old female with a recurrent ductal carcinoma in-site of the right breast, upper inner quadrant, treated previously with three excisions and radiation therapy. She had been offered mastectomy and autologous flap reconstruction at an outside institution, but declined. Instead, she chose an excision with a clam-shell type reconstruction, and a contralateral breast reduction for symmetry. A 175 g specimen was excised and revealed 2.9 cm of ductal carcinoma in situ.

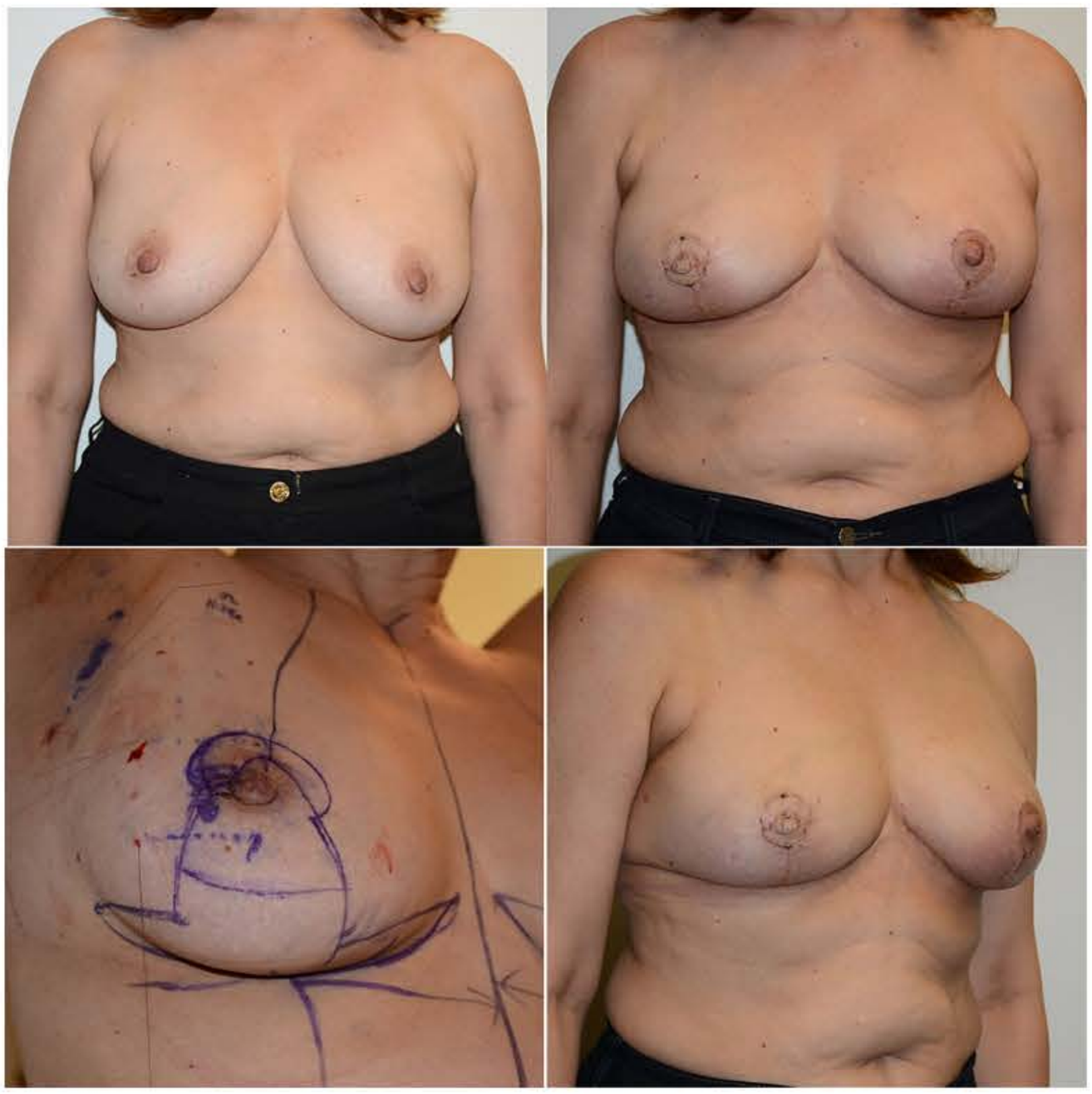


Fig. 6. Central Reduction Technique: 60-year-old female with a right breast invasive ductal carcinoma, involving the nipple-areola complex (NAC). She underwent neoadjuvant chemotherapy followed by a central reduction, with excision of the NAC. The right breast was reconstructed using an inverted T reduction pattern, and immediate NAC reconstruction on an inferiorly based parenchymal segment. The left breast was reduced with a standard Wise pattern technique.

mastectomy is indicated, it is of benefit for the macromastia patient to have had the preliminary skin reduction and NAC repositioning. This patient who, prior to this failed OBS, may not have been a good candidate for NAC sparing mastectomy, can now successfully have the procedure after allowing 1–2 months of healing for revascularization of the NAC.

Contralateral breast. It is expected that surgery of the index breast with OBS will result in breast asymmetry. Given that breast asymmetry after breast conservation is known to impact psychosocial functioning and quality of life, the value of contralateral symmetry surgery is not debated [15]. The ideal timing for surgery of the contralateral breast would be after the index breast has been treated and adjuvant radiotherapy has been delivered. It is well accepted that the index breast will respond to radiotherapy with a variable degree of volume loss, fibrosis, and loss of elasticity. At a second surgery, the contralateral breast can be reduced and lifted for symmetry after these post-radiotherapy changes have stabilized. While ideal symmetry can be achieved in this staged approach, the index breast will continue to slowly shrink for years due to ongoing radiation injury.

When presented with the option of having two separate surgeries over the span of 1–2 years versus having both surgeries performed simultaneous albeit with less accurate symmetry, it is the rare patient that agrees to a staged approach. Virtually all are willing to accept the lesser symmetry from a one-stage approach when educated about the long-term effects of radiation therapy. With that in mind, a small fraction of our patients do return 3–4 years after surgery to have a secondary procedure for the contralateral breast to maintain symmetry.

Volume Displacement Versus Volume Replacement

In general, OBS techniques can be divided into those that displace existing breast volume in the index breast to reconstruct the defect versus those that replace the volume of tissue removed from the breast with regional or distant tissue flaps of varying complexity. The decision to use one or the other depends on the reconstructive needs. Volume displacement techniques offer the simplest solution when there is adequate native breast tissue and the patient accepts a smaller reconstructed breast as well as the need for contralateral surgery to correct asymmetry. Volume replacement allows maintenance of the preoperative breast size, but may require longer surgery, longer recovery, and has associated donor site morbidity. Our practice is devoted to volume displacement reconstruction, and defers to mastectomy only when this is not feasible. In other words, mastectomy, while often appropriate and necessary, is our last choice. It is never our default position.

VOLUME DISPACING ONCOPLASTIC TECHNIQUES

Simple

Glandular flaps. Glandular rearrangement can range from basic undermining and closure of a defect to tissue rearrangement with glandular flaps. The basic technique is to achieve closure of the parenchymal defect independent of the skin. An incision is made purely for access, often within the periareolar border, but it can be anywhere on the breast. Through this incision, skin flaps are elevated, akin to

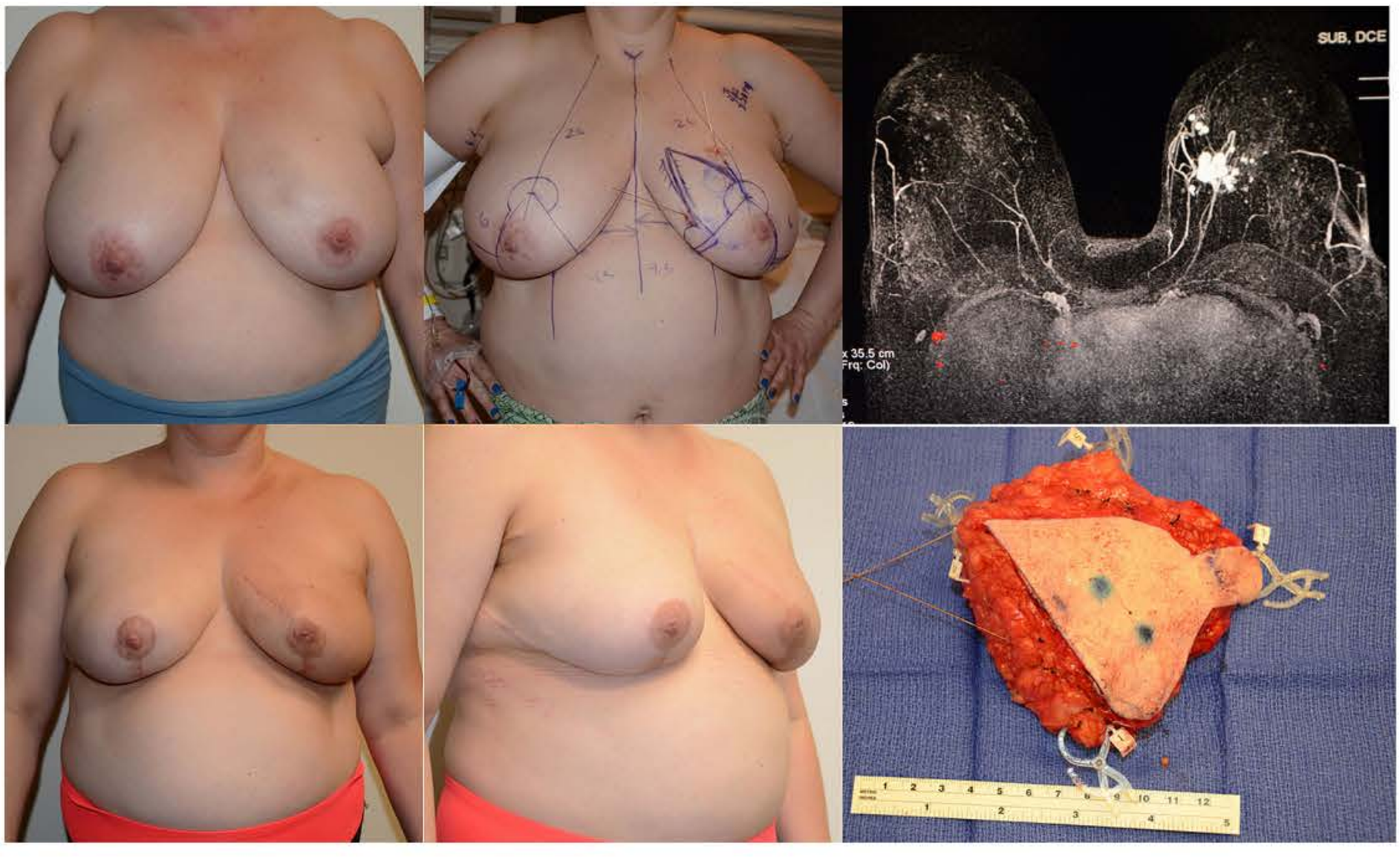


Fig. 7. Split Reduction Technique: A 43-year-old female who had a left breast multifocal invasive ductal carcinoma, with ductal carcinoma in-situ component, in the upper inner breast. There were approximately 20 lesions, spanning $74 \times 72\,mm^2$. After neoadjuvant chemotherapy, she underwent a split pattern reduction of the left breast, and a contralateral Wise pattern breast reduction for symmetry. The specimen weight was 266 g from the upper inner breast, and revealed a 9.5 cm span of multifocal invasive tumors, with clear margins. The postoperative photos demonstrate the final outcome after adjuvant radiotherapy to the left breast.

mastectomy flaps, to expose the involved region of the breast. Once the excision is complete, the adjacent parenchyma is freed from the underlying chest wall fascia. At this point, if primary closure of the defect is possible without deforming the breast, then it is performed with interrupted sutures. If primary closure is not possible, then the parenchyma can be further freed, both from the overlying skin and the underlying fascia. Care must be taken to preserve an adequate blood supply (this technique should be avoided in a predominantly fatty breast to avoid fat necrosis). The mobilized tongues of glandular tissue from both sides of the defect can be then rotated into the defect and sutured. Any dimpling of the overlying skin should be conservatively undermined before skin closure.

Crescent. The crescent mastopexy is a workhorse of oncoplastic surgery for tumors of the upper pole in a mildly ptotic breast. With this technique, we typically limit movement of the nipple-areola complex to 2 cm. The upper hemisphere of the areola is meticulously marked and an analogous second crescent is marked above it, no more than 2 cm higher. The skin within the crescent is excised, and the access to the breast is gained. Once again, skin flaps are elevated to expose the breast gland, and the resection is performed. Glandular advancement of the lower pole parenchyma and overlying NAC is performed and the parenchymal defect is repaired. The incision is then easily closed in layers resulting in minor correction of ptosis (Fig. 3).

Circumareolar/benelli. A circumareolar mastopexy incision, often termed a Benelli mastopexy after Louis Benelli, is the next advancement in the oncoplastic ladder after the crescent mastopexy [16]. This technique allows 360° access to the breast, and is best suited for breasts with minor to moderate ptosis. The final scar in this technique is limited to the circumareolar border. The inner circle is drawn to the desired NAC diameter, within the areola. The outer circle is drawn eccentrically, with its center point higher than the current nipple position—this allows elevation of the NAC upon closure. Conversely, if no upward movement of the NAC is desired, the two circles can be drawn concentrically. The skin within these circles is de-epithelialized. The dermis is then incised 5 mm inside the outer ring, and access to the breast is gained. The skin flaps can be raised circumferentially down to the chest wall, thus retaining the NAC on a central pedicle. Once the entire gland is exposed in this manner, a pie shaped wedge of tissue can be resected easily from any location in the breast and the defect closed with minimal undermining off the chest wall. The skin is then re-draped and the incision closed with a purse-string closure around the areola (Fig. 4).

Batwing. This technique is essentially a crescent mastopexy with two wings on either side of it [17]. It allows a more aggressive mastopexy to be performed without the need for raising skin flaps or creation of pedicles for the NAC. This method is ideal for an upper pole tumor where a wide area of tissue is involved or in a previously irradiated breast where minimal tissue undermining is paramount to avoid tissue necrosis.

Complex

Clamshell. The clamshell technique combines two batwings that are mirror images, drawn opposite each other, with the NAC in between. The center point of these two batwings will determine the new NAC position. The benefit of this technique over a simple batwing is that it allows a larger area of tissue to be excised from an entire hemisphere of the breast. Enough tissue is spared within the clamshell pattern to allow it be de-epithelialized and advanced into the excavated hemisphere. As with the batwing, this procedure is ideal for patients in whom minimal tissue undermining is important. In addition, this technique allows for

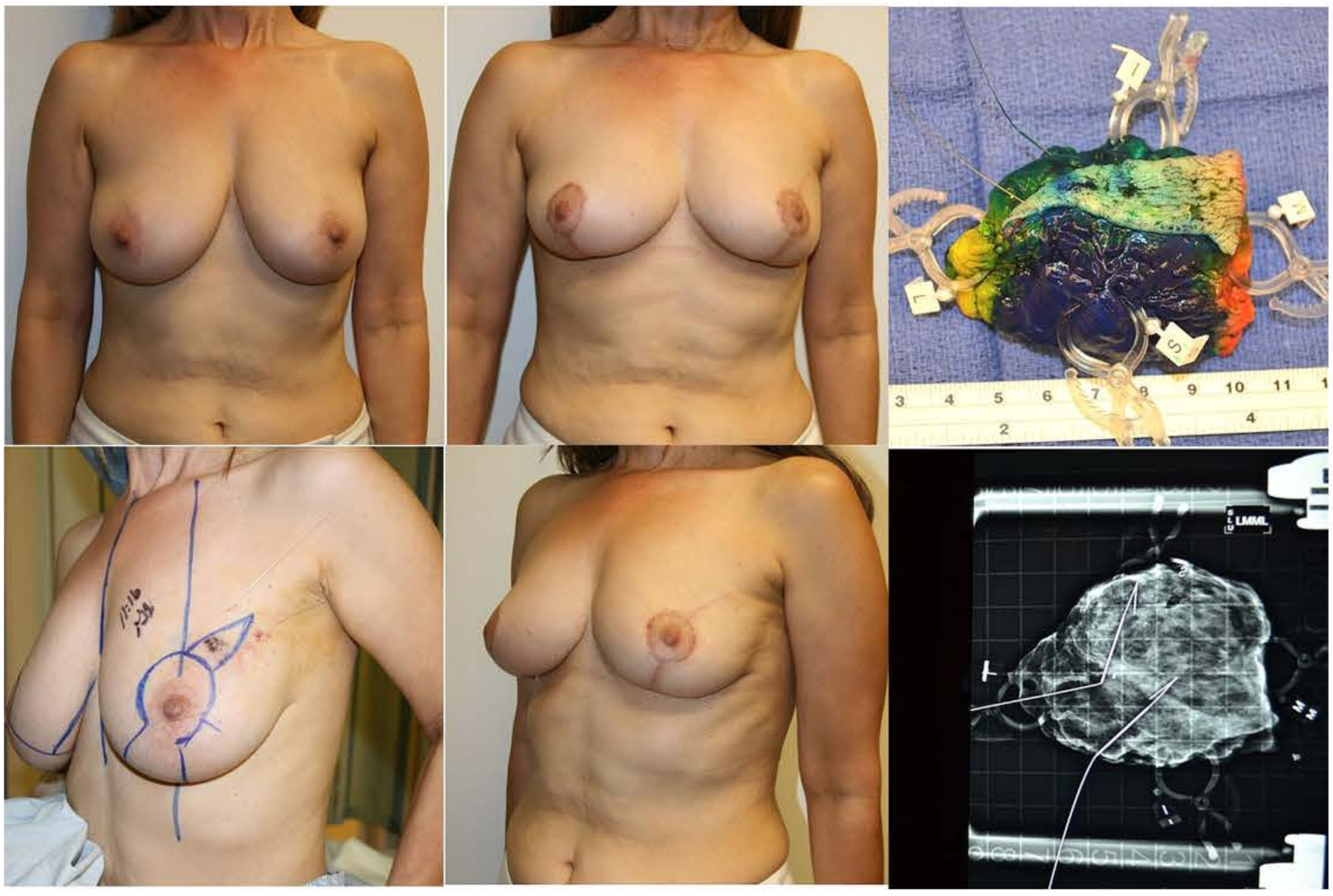


Fig. 8. A 53-year-old female with an invasive lobular carcinoma of the left upper outer breast, spanning 2 cm on MRI. A split reduction pattern was used for the left breast and standard Wise pattern reduction was performed on the right breast symmetry. A 62 g specimen was excised, and revealed a 6 cm invasive lobular carcinoma on final pathology. It is likely that this tumor would have required re-excision or conversion to mastectomy with traditional methods of breast conservation.

breast conservation in patients with multi-centric disease with or without skin involvement (Fig. 5).

Central excision. When the NAC is involved by tumor, the central excision of breast tissue is incorporated into an inverted T mammaplasty that allows for reshaping and immediate NAC reconstruction. This technique takes advantage of breast ptosis to advance an inferiorly based island of tissue into the central defect. It is also feasible to reconstruct a NAC on this island of tissue, which can be tattooed later to complete the reconstruction. Alternatively, the Grisotti technique can be used for smaller defect [18]. It relies on rotation-advancement of a laterally based island, with minimal reshaping of the remainder of the breast (Fig. 6).

Vertical. The vertical scar mammaplasty technique is popular for its power to allow for a breast lift/reduction without a scar along the inframammary crease. For oncoplastic reconstruction, we use it solely for tumors located in the 6:00 position that fall within the standard vertical mammaplasty pattern. A classic vertical scar mammaplasty relies on liposuction for additional contouring [19]; this is used judiciously, or not at all, in oncoplastic reconstruction, to minimize the potential of seeding of tumor cells.

Wise pattern. The workhorse of oncoplastic reconstruction at our facility is the Wise pattern mammaplasty [20]. This powerful technique owes its versatility to several key features. First, it allows the use of virtually any pedicle for the NAC; superior, lateral, medial, inferior, central, and bi-pedicle. Second, significant tissue rearrangement can be performed with multiple secondary pedicles, independent of the NAC. Finally, the wide skin resection allows the most aggressive correction of ptosis. These factors combine to allow exposure to the entire breast, the ability to widely resect tissue from any quadrant, and the opportunity to significantly reduce overall breast volume to aid radiation dose homogeneity.

Split reduction. The main limiting factor of the above technique is the restriction of skin resection to those described for the traditional Wise pattern (generally the lower inner and outer quadrants of the breast). The need to be certain of the anterior tumor margin led our group to develop the Split Reduction. The main strength of the Wise pattern is the independence of the skin resection and the parenchymal resection. The parenchymal reduction does not need to follow the skin reduction pattern; the end goal is creation of a breast mound over which the skin can be re-draped. For an aesthetic breast reduction, it is desirable to place the scars in the least visible areas. Thus, the Wise pattern is designed to limit the scars to the circumareolar border, the vertical midline of the breast, and the inframammary crease. For oncoplastic breast surgery, we do not need to limit ourselves to this ideal skin pattern. Since the need for tumor clearance trumps this aesthetic ideal, we may modify the traditional Wise pattern to displace a hidden scar from the medial or lateral IMF onto the visible breast, directly over the tumor. This modification, that we term a Split Reduction, allows definitive clearance of the anterior (skin) margin. The end result is resection of the same amount of skin as a traditional Wise pattern, but higher visibility of the scar. In our opinion, this trade-off is acceptable, since the alternative of a close or involved anterior margin, leading to mastectomy is avoided (Figs. 7–9).

SUMMARY

The techniques discussed here are our most commonly used methods of oncoplastic reconstruction. The premise of each technique is discussed, but each must be individualized for the patient at hand. Many patients present to us seeking breast conservation after having been told elsewhere that it

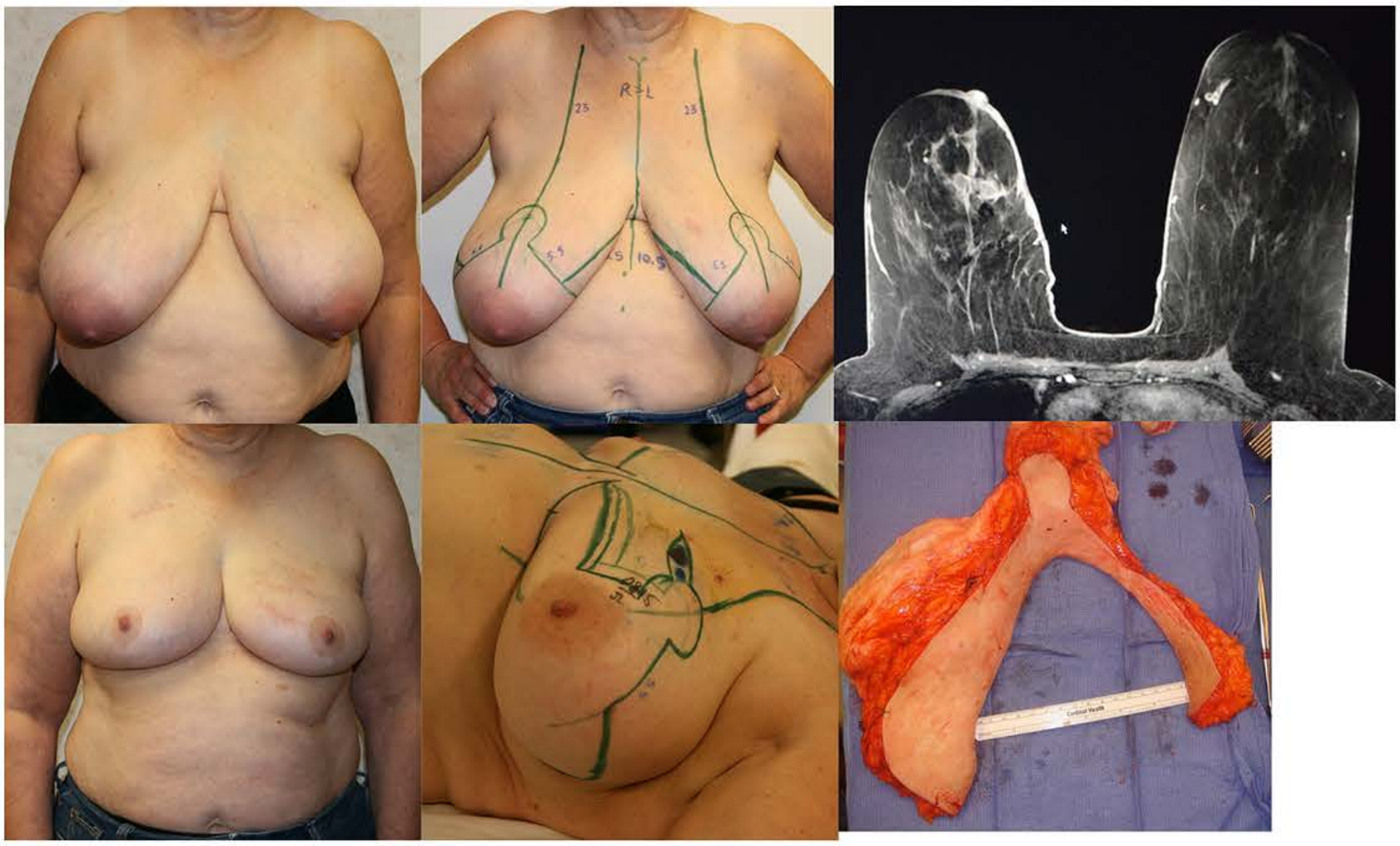


Fig. 9. Split Reduction Technique: A 56-year-old female with a left breast invasive ductal carcinoma and ductal carcinoma in-situ of the upper inner quadrant, spanning 19 mm on mammography. She underwent a split reduction pattern excision of the tumor, yielding clear margins. In addition, the left breast was significantly reduced, and a contralateral Wise pattern breast reduction was performed for symmetry. The final results shown are 1 year after adjuvant radiotherapy to the left breast.

would be technically challenging or impossible. A large number of these women have been spared mastectomies by using the carefully selected techniques described. We often make intraoperative adjustments to the pre-operative markings to modify the skin. We modify the pedicle for the NAC if there is a need to rotate or advance parenchyma into defects. Secondary and tertiary parenchyma-only pedicles are often used to reconstruct defects as well. Ultimately, we go to surgery with a preemptive plan for reconstruction, but are prepared to change when necessary. The ability to remain flexible is important, and we try to maintain all of our reconstructive options until we are ready to commit.

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