Review Article

# Oncoplastic surgery in the USA: a review of where we started, where we are today and where we are headed

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*Contributions:* (I) Conception and design: All authors; (II) Administrative support: All authors; (III) Provision of study materials or patients: GDP Garcia Nores; (IV) Collection and assembly of data: LM Willcox, GDP Garcia Nores; (V) Data analysis and interpretation: LM Willcox, GDP Garcia Nores; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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**Abstract:** The surgical management of breast cancer has evolved tremendously over the last century and now includes oncoplastic techniques that improve both cosmetic and oncologic outcomes for patients. The purpose of this review is to provide the reader with a broad overview of the history of oncoplastic breast surgery in the United States (USA), and to summarize important patient factors and technical innovations for optimal operative planning in the era of multimodal treatment of breast cancer. The indications for oncoplastic surgery (OPS) have broadened significantly as more women pursue breast conservation with preservation of their native breast tissue. The operative philosophy of OPS is based on fundamental reconstructive principles, with technique selection based largely on tumor size and location. Reduction mammoplasty and mastopexy techniques have become some of the most utilized procedures in OPS due to their versatility to address tumors in almost all areas of the breast. Volume replacement techniques with locoregional perforator flaps continue to gain popularity as a single-stage reconstructive option for women with large tumor to breast ratios, especially with specialized plastic surgeons at high volume, academic centers. The oncologic advantages of OPS have allowed women to avoid mastectomy with improved margin control, re-excision rates, and equivalent overall survival all while preserving the aesthetic outcomes for these patients. Despite the proven benefits of OPS, numerous healthcare systems barriers including insurance status, geographic location, referral patterns, and racial disparities all continue to play a role in access to surgical sub-specialized breast oncology care demonstrating the need for ongoing research and education about oncoplastic principles.

**Keywords:** Oncoplastic breast surgery; oncoplastic breast reduction; oncoplastic surgery (OPS); breast cancer reconstruction

Submitted Sep 13, 2023. Accepted for publication Mar 25, 2024. Published online May 16, 2024.
doi: 10.21037/gs-23-363
**View this article at:** https://dx.doi.org/10.21037/gs-23-363

## Introduction

### *History, evolution, definition, and practice of oncoplastic surgery (OPS) in the United States (USA)*

The standard of care for patients with breast cancer has evolved remarkably over the past 120 years. From the first description of a radical mastectomy by Halstead in 1894, to the current paradigm of multimodal treatment for breast cancer, including neoadjuvant and adjuvant chemotherapy, radiation, and surgery, women diagnosed with breast cancer are living longer, with improved cancer related mortality. In pairing with advances in chemotherapy and radiation

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treatment, the surgical approach to breast cancer resection has also progressed. It is now well established that for women with early-stage breast cancer, mastectomy and breast conservation therapy (BCT; partial mastectomy plus radiation) have equivalent disease free, and overall survival rates (1-3). Over the years, BCT has increased in popularity with both patients and physicians alike, mainly due to the ability to preserve native breast tissue. However, this practice has also been associated with negative postoperative outcomes including unfavorable scarring, skin dimpling, and deformity (4). Up to 30% of patients that undergo BCT will experience a poor aesthetic result, hence the need for techniques that use the patient's own breast tissue to prevent these feared complications (5). In the 1980s, Dr. Werner Audretsch developed several volume displacement techniques to improve the appearance of these partial mastectomy defects and is credited as the pioneer and creator of the phrase "oncoplastic surgery".

In 2019, the American Society of Breast Surgeons aimed to create a consensus definition and classification system of OPS to create a common language for surgeons and trainees (6). The current definition of oncoplastic breast surgery includes the immediate reconstruction of a partial mastectomy defect using key plastic surgery principles for tissue rearrangement. This approach has now become a cornerstone practice of reconstructive surgery. This article will focus on the term "oncoplastic breast surgery" as it relates to a surgical procedure performed at the time of partial mastectomy. It involves the concept of reshaping the breast, based on the homogenous distribution of the remaining breast parenchyma and fatty tissue (7). It can be separated into volume replacement and volume displacement techniques. In the seminal article published by Clough *et al.* in 2010, volume displacement reconstruction techniques based on excision size and complexity are classified into two major categories. A level I procedure is categorized based on a smaller volume of excision, less than 20%, with no requirement for skin excision or mammoplasty, in the presence of dense glandular tissue (8). A level II procedure is categorized by a larger excision volume ratio of 20–50%, with the need for skin excision, concurrent mammoplasty, and the presence of either dense or fatty breast tissue (8). Generally, level I techniques can be performed by the breast surgical oncologist, while the complexity of level II techniques requires the expertise of a plastic surgeon. In the USA, OPS is most commonly performed in a team-based approach with the oncologic breast surgeon and the plastic surgeon working together to maximize both oncologic and aesthetic outcomes for the patient.

Oncoplastic breast surgery continues to gain popularity worldwide. It should be noted, that the adoption of oncoplastic reconstruction lagged behind that of our European counterparts. This is due in part to the fact that breast oncologic surgery is often handled in a multidisciplinary fashion in the USA, whereas in Europe, the gynecologic and or breast surgeon performs the reconstruction. Comparatively, fewer quadrantectomies are performed in the USA than in European Nations. The annual growth rate of OPS in the USA is estimated at 9% per year, with the most common procedures being volume displacement (47%), breast reduction (20%), volume reduction (17%), and mastopexy (9%) as well as local tissue transfers (9).

We are slowly adopting these new techniques mainly due to their benefits and patient satisfaction which drive referrals from breast surgeons. Despite this increase in OPS across the USA, only 4.2% of women who underwent a partial mastectomy between 2006 and 2015 also underwent an oncoplastic breast procedure (9). Furthermore, there seems to be an acute desire in smaller-breasted women for mastectomy *vs.* lumpectomy and oncoplastic reconstruction when compared to other parts of the world. Barriers to receiving both OPS and post-mastectomy reconstruction in the USA are multifactorial and include major healthcare systems-based issues such as access to healthcare, insurance status, race/ethnicity, socioeconomic status, geographic location, surgeon factors, and appropriate referral to a plastic surgeon (10-12). Access to a plastic surgeon can further propagate inequality in breast cancer care, thus, the need for continued education and streamlined training of general surgeons, breast surgeons, and plastic surgeons, on the principles and maintained safety of OPS, is paramount for women with breast cancer in the USA. Some studies have suggested standardization of OPS techniques and referral patterns in other countries, however this does not currently exist in the USA (13). It is anticipated with the continued adoption and recognition of OPS principles, that plastic surgeons will transition to focus on more advanced and complex level II, and volume replacement techniques. Formalized education of OPS techniques in breast fellowships will be necessary to meet the ongoing patient demands secondary to improved aesthetic outcomes associated with OPS (14). Additionally, it is well established that surgeon recommendations, and approach in discussing surgical management of breast cancer, specifically breast reconstruction, has a strong impact on patient decision making (15). With improvement in knowledge base and training of OPS techniques, the limitation on access may be partly mitigated moving forward.

### *Indications for OPS*

The indications for performing OPS are two-fold. Historically, women who are candidates for BCT are also eligible for OPS. This includes patients that the surgical oncologist deems the ability to achieve an adequate oncologic excision is possible with lumpectomy alone, with "no ink on tumor" for invasive carcinomas or 2 mm margins for ductal carcinoma in situ (DCIS) pathology (16). Typically, patients are eligible for BCT with T1 and T2 tumors, without contraindications to adjuvant radiation (16). However, with OPS, increased excisional volumes can be obtained in larger-breasted patients, thus the indications for breast conservation are somewhat expanded. The ability for larger resections, allows women who traditionally would have only been a candidate for mastectomy or major flap reconstruction, to pursue a potentially less invasive surgical option. Secondarily, OPS techniques allow for these increased excisional volumes without compromising aesthetic quality and minimize the potential for poor cosmesis following surgery.

### *Considerations for OPS*

Preoperative planning for patients undergoing OPS is multifaceted and must take patient factors, tumor characteristics and location, and need for neoadjuvant chemotherapy into consideration. Patient factors such as body mass index, history of diabetes mellitus, connective tissue or blood clotting disorders, smoking history, pre-existing musculoskeletal issues of the shoulder, and prior radiation to the chest wall should be evaluated preoperatively.

From an anatomical standpoint, breast size, degree of ptosis, typical measurements including notch to nipple distance, nipple to inframammary fold distance, symmetry and skin quality should be noted. Additionally, glandular density of the breast which can be assessed both clinically and mammographically, can also be useful with operative planning, as lower density, high fat tissue is more susceptible to necrosis with aggressive undermining (8).

Tumor size and excisional volume in relationship to breast size have been described as the most important preoperative factors when determining postoperative aesthetic outcomes (17). For simple lumpectomy specimens, ratios can range from 0.08% to 2.95% (18). For larger specimens, tumor to breast ratios that exceed 20% are more likely to be associated with poor cosmesis, thus oncoplastic techniques are typically most effective for patients with large tumors and large breasts (17). It is also important to recognize that tumor location can dramatically impact the degree of postoperative deformity even for smaller lumpectomy specimens. Cancers in the lower poles, and upper inner quadrants can pose more of a challenge due to factors including skin retraction, and downward or lateral displacement of the nipple areolar complex (NAC) (8). A contralateral symmetrizing procedure including breast reduction or mastopexy may also be warranted based on excision volume which is typically performed at the time of initial surgery. Intra-operatively, it is also important to consider the variable effects of postoperative radiation on breast size, skin quality, fibrosis, swelling, and patient characteristics (19). To account for contracture of the affected breast following whole breast radiation, traditionally, the contralateral breast is made 10–15% smaller to account for this predicted result. New radiation protocols are helping to alleviate these issues, however managing postoperative radiation changes continue to pose an ongoing challenge for plastic surgeons.

For women who undergo neoadjuvant chemotherapy, laboratory assessment of white blood cell count, hemoglobin, and platelet count, should be performed with a general consensus that chemotherapy should be completed 2 to 4 weeks prior to undergoing surgery with normalization of laboratory values. For women on hormonal or endocrine therapies such as tamoxifen, it is recommended to consider discontinuation of the medication for 3 weeks preoperatively in high-risk patients due to the increased postoperative risk of developing a deep vein thrombosis (20,21). Furthermore, a preoperative discussion with the surgical oncologist is recommended, to review the placement and trajectory of a wire for tumor localization and compare this to the planned incision location and shape (i.e., periareolar, inframammary, ellipse, etc.), as well as to review all radiographic data (22).

### *Contraindications to OPS*

Major contraindications to immediate oncoplastic breast surgery include diffuse multifocal disease, history of chest wall radiation, inflammatory breast cancer, patients who are not a candidate for BCT, major skin involvement, or patients with insufficient remaining breast tissue (23). Additional relative contraindications include active tobacco use, or poorly controlled diabetes mellitus due to the increased risk of wound complications (5).

## Operative principles of OPS, categorized by volume of excision and tumor location

### *Operative principles: small volume excisions*

Level I volume displacement OPS involves undermining and reconstruction of the breast with glandular shelves. There are multiple key principles to ensure an optimized operative result. Clough *et al.* (8) outlines six basic steps when performing a level I OPS which include: incision, undermining of the skin and NAC, a full thickness glandular excision down to pectoral fascia, tissue re-approximation and repositioning of the NAC if needed. There are a few named excision types, including the radial ellipse segmentectomy, and the circumareolar approach that have been described which can be used for almost any quadrant of the breast (24). Incision length should not interfere with appropriate resection of the specimen *en-bloc* with clear and wide oncologic margins (8). Smaller incisions can also hinder breast parenchymal and glandular undermining which is an important aspect of adequately reshaping the breast (8). Incision location is determined by tumor location and surgeon preference and should generally follow Kraissl's lines to limit tension and improve scarring. Skin undermining should follow the mastectomy plane, for up to 2/3 of the breast envelope (8). When undermining the NAC, 0.5–1 cm of remaining tissue should be intentionally left posteriorly, if feasible from an oncologic standpoint, to preserve blood supply (8). Following specimen excision, it is important close the lumpectomy defect with the mobilized glandular flaps to minimize the risk of postoperative seroma which can lead to eventual fibrosis and distortion of the NAC in more final stages of healing (8).

### *Operative principles: large volume excision, volume displacement*

For larger defects with excision volume greater than 20%, the most functional options for immediate breast reconstruction include both mastopexy and reduction techniques. These techniques tend to have the best cosmetic results in patients with larger, ptotic breasts where there is an adequate volume of remnant breast tissue that remains for reshaping of the mound. Wise pattern incisions are the most versatile, and can be utilized for most breast tumor locations, as this incision pattern encompasses a large geographic area of the breast. Similar to incision location in level I OPS, pedicle selection is based upon tumor location. Generally, if the pedicle either points towards or can be rotated into the defect left behind by the excision, it can be used (23). Reductions in the affected breast will result in a breast that is smaller and lifted, with improved projection, thus a similar excision and operative approach should be used to reshape the contralateral breast for symmetry.

### *Lower pole/quadrant tumors*

For tumors in the lower pole, lower inner and outer quadrants of the breast there are a variety of techniques that can be taken advantage of for oncologic excision and reduce the likelihood of a bird beak deformity or a contracture of the inferior pole. Reduction mammaplasty with superomedial pedicle selection is the most preferred in our practice, as it preserves medial breast fullness for cosmesis, facilitates the correction of the inframammary fold, and repositioning of the NAC (25). Incision type can be an inverted T, or a wise pattern/key hole incision. The basic technical aspects are similar to that of a standard breast reduction which includes de-epithelialization of the NAC, undermining of the breast tissue down to the pectoral fascia to include the tumor specimen towards the inframammary aspect of the incision, followed by the creation of a superior based dermo glandular pedicle and closure of the medial and lateral pillars to reshape the breast (*Figure 1*) (7). The nipple is then repositioned at the peak of the new breast mound. Key principles include preserving the blood supply to the NAC, pedicle, and remaining breast parenchyma. The advantages of reduction mammaplasty allow for a generous resection specimen and broaden the indications for the pursuit or BCT in patients with larger size tumors. It also offers an element of improved overall cosmesis in women with baseline ptotic breasts.

Additional oncoplastic techniques that have been discussed in the literature for lower pole tumors include more simplistic incisions like inframammary, or triangle incisions. An inframammary resection is indicated for cancers in the lower, and more posterior region of the breast. The incision is made in the inframammary fold, with the initial dissection followed posteriorly along the retromammary fat plane to a minimum of 3 cm superior to

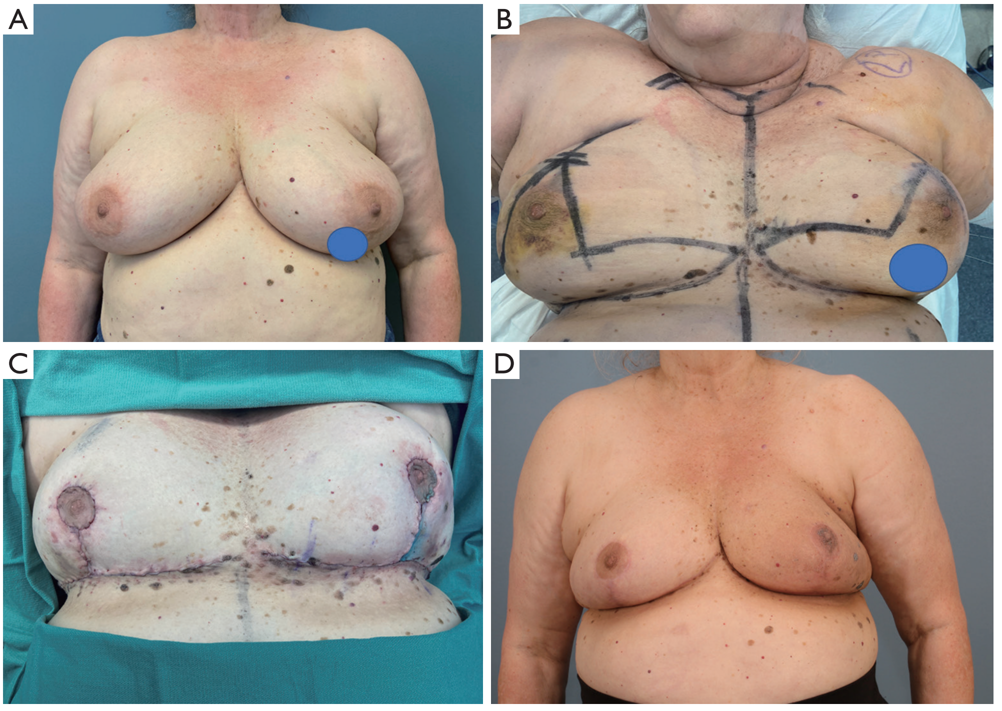


**Figure 1** Superomedial pedicle oncoplastic reduction. (A) Preoperative photograph with location of the area to be excised (blue circle). (B) Preoperative markings with location of the area to be excised (blue circle). (C) Intraoperative immediate result after superomedial pedicle. (D) Postoperative result 3 months after surgery and 1 month after radiation.

the malignancy (24). Due to the special orientation of this technique, utilization of multiple localizing wires or intra-operative ultrasound of the specimen is recommended to ensure margin clearance (24). A triangle resection involves two parallel horizontal curvilinear incisions at the inferior border of the areola and inframammary fold followed by a wedge shaped, full thickness excision that avoids undermining the NAC, with a medial rotation of the glandular flap to fill the defect. Advantages to both of these approaches include the incision location, periareolar and in the IMF, which typically heal well with hidden scars, as well as ease of closure. For the three techniques described above including reduction mammoplasty, the corners of the dermoglandular flaps are the must susceptible to breakdown and ischemic necrosis due to inadequate blood supply, so it is necessary to be especially careful with tissue handling of these regions to preserve the subdermal plexus as much as possible (24). To help mitigate this potential complication, an area in the midline of the IMF can intentionally be left longer, in an inverted V shape to fill the defect if the corners need to be excised prior to closure (24).

### *Tumors involving the NAC*

Central and subareolar tumors can be addressed with similar mammoplasty techniques described above for lower pole tumors, with the exception of inframammary or triangle approaches. For cancers that specifically involve the NAC, the B-flap resection or Grisotti mastopexy, have been described. The B-flap resection is indicated in women with moderate ptosis, and sufficient breast tissue with distance from nipple to IMF of at least 8 cm (24). Key aspects of the reconstruction include a “B” shaped incision, with the first incision made circumferentially around the areola, followed by a second circular incision inferiorly to create a disk of skin that will be utilized to construct a neo-areola. The native NAC and glandular tissue (containing the tumor) beneath is excised in a cylindrical fashion down to the pectoralis fascia, and an inferior-lateral pedicle of glandular tissue mobilized from the upper outer quadrant from below the new skin disk is rotated medially and superiorly into the defect (24). Newer techniques developed by Hamdi *et al.*, have described another option for central breast

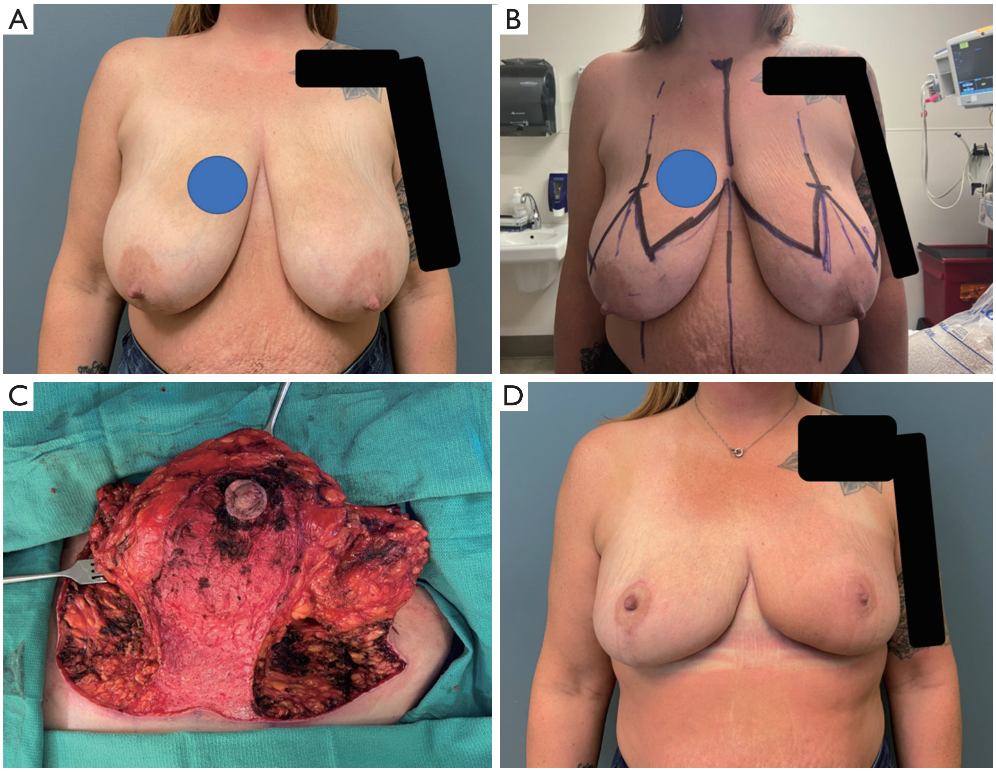


**Figure 2** Inferior pedicle oncoplastic reduction. (A) Preoperative photograph with location of the area to be excised (blue circle). (B) Preoperative markings with location of the area to be excised (blue circle). (C) Intraoperative dissection of the Inferior pedicle. (D) Postoperative result 3 months after surgery and 1 month after radiation.

defects using an infero-central septum-based island pedicle, based on intercostal perforators with immediate nipple reconstruction (26).

### *Central and upper quadrant tumors*

For tumors in the central portions of the breast that do not involve the NAC, or upper quadrant tumors, the same mammoplasty techniques as described above with a classic inferior pedicle design can be utilized (*Figure 2*). The batwing mastopexy is another technique for tumors in the upper central breast, with additional inclusion of tissue both medial and lateral to the nipple. This is an option for patients with tumors that may not be amendable to a simple periareolar incision and excision with the additional benefit of correcting ptosis. The hemi-batwing resection is an iteration of the batwing mastopexy that is best used for wide excisions of upper outer quadrant tumors. While batwing approaches are well described, they have fallen out of favor due to unfavorable scarring. The donut mastopexy or round block technique with a purse string closure technically allows access to any quadrant of the breast but is most suited for upper pole tumors, it can be difficult to create glandular shelves for reshaping given the somewhat restrictive skin incisions.

### *Operative principles: large volume excisions >30%, volume replacement*

For women with large tumors and small breasts who elect to purse breast conservation, the remaining breast tissue is often not enough for reconstruction with a volume displacement technique alone. Volume replacement techniques can be used to replace defects for up to 90% of the breast with local tissue transfer, and allow for preservation of breast shape and contour. Locoregional perforator-based flaps continue to gain popularity in reconstructive breast surgery for partial mastectomy defects, especially at academic, high-volume centers, due to the benefits of preserving muscle, and underlying functional motor nerves. Indications for locoregional flaps can also include management of prior postoperative complications as a salvage procedure, history of partial or total free flap loss, and be combined with implant-based reconstruction techniques in large-volume breasts (23). Pedicle-based perforator flaps have the advantage of avoiding the morbidity of abdominal-based free flaps, and allow for a single-stage reconstruction option. Similarly to mammoplasty, it is our practice to intentionally mobilize a larger flap to account for the effects of radiation fibrosis. Ultimately, the decision of flap selection is based on tumor location, surgeon preference, patient body habitus, and prior history of breast reconstruction.

The latissimus dorsi (LD) musculocutaneous flap is one of the most well-known and commonly used flaps due to its anatomic predictability and indication for breast defects in any quadrant. It is commonly compared to the most frequently used locoregional perforator flap, the thoracodorsal artery perforator flap (TDAP) (23,27). The TDAP flap uses a similar skin island to the LD flap, and its blood supply can be based on either the intercostal vessels or the thoracodorsal artery. It can have a pedicled length of up to 25 cm, and the advantages over the classical LD flap include decreased donor site morbidity, preserved strength and range of motion of the upper extremity, and improved aesthetic outcomes (28). It also does not require true microsurgery, but a loupe-guided dissection and is indicated in upper inner quadrant, central, inferior, and lateral breast defects.

The two most commonly described perforator flaps based on the intercostals include the lateral intercostal artery perforator (LICAP) flap, and the anterior intercostal artery perforator (AICAP) flap. The indications and benefits of the LICAP flap include defects in the superior and inferior lateral quadrants of the breast, simplicity of the dissection, with the flap itself based on the lateral chest roll and the ability to create large skin paddles, up to 35 cm (28). The disadvantages include a shorter pedicle length comparted to the TDAP, and risk of pneumothorax due to the close proximity to the chest wall (28). The AICAP flap is based on branches from the internal mammary artery, and can be used mainly for inferior lateral and inferior medial defects. Given the short pedicle, it is best suited for patients with smaller breasts (27,28).

The lateral thoracic artery perforator (LTAP) flap is based on a branch of the axillary artery and is indicated for lateral breast defects. The benefits include the ability to revert to a LD musculocutaneous flap if needed. It should be noted that it may be contraindicated in patients with a prior axillary lymph node dissection due to the potential of ligation of blood supply (28). For patients that autologous reconstruction is not possible, when oncological safety can be achieved, a nipple-sparing mastectomy with immediate implant-based reconstruction is an alternative.

### *Recovery, complications following surgery*

Complications following OPS include infection, seroma, hematoma, delayed healing, skin necrosis, necrosis of the NAC and wound complications. Based on the literature, the overall complication rate is significantly varied and can range anywhere from 9% to 33% (29-31). However, despite the increased surgical complexity of OPS, multiple studies have demonstrated the complication rates are similar to partial mastectomy, and generally, the need for complications requiring a return trip to the operating room is low (32). A study completed by Brown *et al.*, in 2021 reported the overall major complication rate requiring operative intervention at 8.9%, with the most common reasons being hematoma evacuation and infection (31). Level II OPS techniques have been independently associated with higher rates of delayed wound healing, and increased rates of chronic postoperative pain when compared to level I techniques (33). Patient specific factors that have been associated with higher rates of postoperative complications include obesity, smoking, diabetes, bleeding disorder, chronic obstructive pulmonary disease, and American Academic of Anesthesiologists (ASA) category 3 or 4 (32).

Oncologic indications for a secondary surgery include margin re-excision, conversion to a completion mastectomy, however multiple studies have demonstrated that rates of margin re-excision with OPS, are less than that of partial mastectomy (34). A meta-analysis by Losken *et al.* reports the rates of reoperation for margin re-excision and completion mastectomy following OPS are estimated at 4% and 6.5%, respectively (34). Beyond the immediate postoperative and oncologic indications for a secondary surgery, a portion of patients will pursue surgical management for aesthetic improvement after the index operation. These revision procedures can include autologous fat grafting, especially in the medial aspect of the breast, scar revision, and reduction, and are typically performed in a younger patient demographic (31).

### *Patient satisfaction*

Improved aesthetic outcomes were initially the main driving force behind the development of oncoplastic breast surgery with good cosmetic outcomes reported in as high as 90% of patients (35). To date, multiple studies have since demonstrated improved patient satisfaction following oncoplastic reconstructive surgery when compared to other forms of breast surgery for cancer which include: BCT alone, mastectomy, flap reconstruction, and mastectomy with reconstruction (36-39). Additionally, factors related to improved quality life including physical well-being, satisfaction, and sexual well-being have not been show as inferior to BCT despite the increased complexity and postoperative recovery (36,40).

### *Oncologic benefits and safety of OPS*

While the initial reason for the development and adoption of oncoplastic techniques in breast reconstruction was based on improving aesthetic outcomes, a secondary and perhaps more important benefit has been the oncologic benefits from OPS. Most notably, OPS has expanded the indications for BCT as women who were previously not candidates for this option due to large tumor size or location can be offered BCT without compromising on the oncologic safety. It has been demonstrated that OPS can be performed safely in women with tumors >5 cm, and even in cases of multifocal disease with similar recurrence rates to the traditional candidates for BCT (41-43). The principles of OPS allow for a more generous specimen excision, which translates to improved margin control and decreased re-excision rates when compared to BCT alone (34,44). Furthermore, there is an increasing body of literature that demonstrates there is no difference in recurrence-free survival and overall survival when comparing patients who undergo OPS *vs.* BCT alone with low-stage breast cancers (29,45,46). For women who require a symmetrizing procedure, there is an additional oncologic benefit of undergoing a contralateral breast reduction. Studies have shown that breast cancer risk decreases proportionally to the amount of tissue excised at the time of surgery (47). A Swedish study published in 2006, demonstrated a 30% reduction in breast cancer-specific mortality for women who underwent a breast reduction (48).

Many have feared OPS has the potential to interfere with the multimodality nature of breast cancer treatment given the increased surgical complexity and higher complication rate when compared to partial mastectomy. While this continues to be an ongoing area of research, a recent study for patients that received neoadjuvant chemotherapy followed by OPS, found that after adjusting for clinicopathologic risk factors, preoperative chemotherapy was not associated with an increased risk of perioperative complications (49). It is important to note that when postoperative complications do occur following OPS, this can delay the initiation of adjuvant radiation therapy which directly impacts cancer-specific mortality (50). A study by Kapadia *et al.* found in the complication group, time to receipt of radiation was 74 days when compared to the non-complication group of 54 days ($P<0.01$) (51). Recent studies have demonstrated lower rates of postoperative wound complications with the utilization of closed incision negative pressure therapy, with decreased rates of skin necrosis, and dehiscence to aid in improving these delays to adjuvant radiation (52). This illustrates the need for appropriate preoperative evaluation and optimization with careful patient selection.

There have been additional concerns related to the degree of tissue remodeling that occurs during OPS and the feasibility of delivering postoperative radiation accurately. Typically, clips are placed by the breast oncologic surgeon once the resection has been performed. A study by Gladwish *et al.* determined OPS did not impact the ability to deliver boost radiation (53). Additionally, new technologies, including three-dimensional bioabsorbable tissue markers, are emerging to help identify the resection cavity radiographically in OPS (54).

The final key principle of postoperative cancer treatment and evaluation includes surveillance. Oncoplastic techniques do not interfere with the ability to perform mammograms, mammographic sensitivity, nor does it lead to increased rates of postoperative biopsies when compared to lumpectomy (55,56).

## Conclusions

OPS has now become a key component of cancer care for women with breast cancer and its utilization in the USA continues to increase annually. Building on the basics of reconstructive principles, OPS offers a wide variety of benefits for women with breast cancer including improved cosmesis, postoperative satisfaction, broadened indications to pursue breast conservation surgery, with maintained oncologic safety and the added benefit of improved margin control.

## Acknowledgments

*Funding:* None.

## Footnote

*Provenance and Peer Review:* This article was commissioned by the Guest Editors (Tine Engberg Damsgaard, C. Andrew Salzberg and Jørn Bo Thomsen) for the series "Hot Topics in Breast Reconstruction World Wide" published in *Gland Surgery*. The article has undergone external peer review.

*Peer Review File:* Available at https://gs.amegroups.com/article/view/10.21037/gs-23-363/prf

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-23-363/coif). The series "Hot Topics in Breast Reconstruction World Wide" was commissioned by the editorial office without any funding or sponsorship. A.L. is a consultant for RTI surgical. The authors have no other conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All clinical procedures described in this study were performed in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patients for the publication of this article and accompanying images.



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**Cite this article as:** Willcox LM, Losken A, Garcia Nores GDP. Oncoplastic surgery in the USA: a review of where we started, where we are today and where we are headed. Gland Surg 2024;13(5):749-759. doi: 10.21037/gs-23-363

 