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Impact of Oncoplastic Surgery on Oncologic Outcomes in Patients with Breast Cancer

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Background: For patients with breast cancer, oncoplastic surgery (OPS) serves as a valuable technique that allows for immediate reconstruction at the time of resection. While the aim of OPS is to improve breast cosmesis, it is critical to ensure OPS does not negatively impact appropriate cancer treatment.
Methods: Based on current literature, this study provides a broad overview on the potential oncologic advantages of OPS for patients diagnosed with breast cancer.
Results: OPS has been shown to be a safe and reliable approach with oncologic advantages. More specifically, OPS broadens the indications for breast conservation therapy (BCT); allows for a more generous margin of resection, thus decreasing rates of re-excision; and provides the opportunity to sample additional breast tissue, which may detect occult disease. Reduction mammaplasty may also decrease the risk for developing breast cancer. Importantly, in the era of multimodality therapy, long-term oncologic outcomes and postoperative surveillance algorithms appear to be similar when comparing patients who undergo OPS and BCT.
Conclusions: For patients with breast cancer, oncoplastic surgery has emerged as a valuable technique to improve breast cosmesis while achieving optimal oncologic outcomes. As the landscape of breast oncology continues to evolve, it is critical for a multidisciplinary team to be involved to guide management and reconstructive strategies. *(Plast Reconstr Surg Glob Open 2024; 12:e5561; doi: 10.1097/GOX.0000000000005561; Published online 30 January 2024.)*

INTRODUCTION

In patients with breast cancer, advances in oncoplastic techniques have resulted in higher rates of patient satisfaction with improved breast cosmesis (Fig. 1).[1] Immediate reconstruction after partial mastectomy at the time of resection is referred to as oncoplastic surgery (OPS). In recent years, it has become evident there are potential oncologic benefits with this approach. OPS involves reshaping the breast parenchyma and fatty tissue to create a cosmetically acceptable new breast shape after an extirpative surgery. Clough et al helped delineate two major oncoplastic categories, which include reconstructive based on (1) volume of breast tissue resected or (2) complexity.[2] The majority of OPS requiring the expertise of a plastic surgeon falls into the latter category of complexity. Plastic surgeons use a variety of mastopexy and reduction mammoplasty techniques, often accompanied by a symmetrizing procedure to the contralateral breast. The focus of this study includes the oncologic outcomes related to volume displacement techniques.

OPS broadens the indications for breast conservation therapy (BCT); allows for a wider margin of resection, thus improving rates of microscopically negative margins (R0 resection); and decreases rates of re-excision. Although the impetus for OPS was optimizing aesthetic outcomes, it is critical to ensure that the addition of partial reconstruction does not negatively impact appropriate cancer treatment. The purpose of this review is to focus on the oncologic aspects of OPS, to understand the oncologic benefits, and to ensure that cancer treatment and surveillance are not adversely affected.

BROADENED INDICATIONS FOR OPS

OPS has expanded the indications for BCT, allowing for more patients with breast cancer to avoid mastectomy and more extensive reconstructive operations.[3] Patients previously deemed unsuitable for BCT due to tumor size and/or location can now be offered OPS to achieve optimal cosmetic and oncologic outcomes. This is particularly relevant in the era of multimodality therapy, where OPS is a viable

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option for patients whose tumors respond to preoperative systemic therapy.[4,5] Two recent retrospective cohort studies demonstrated that OPS can be performed safely in patients, including those with breast tumors of 5-cm size or more and/or those with multifocal disease.[6,7] A 2019 retrospective study by Niinikoski et al reported that patients who underwent OPS were more likely to have multifocal disease, larger tumors, palpable tumors, higher histological grade, higher T-stage, and lymph node involvement (all $P < 0.01$).[8] In a study of 66 patients with multifocal, multicentric, or locally-advanced tumors of more than 5-cm size who underwent OPS, Silverstein et al reported a 1.5% 2-year recurrence rate, which is similar to recurrence rates seen with BCT.[9] For well-selected patients, OPS seems to be an effective and safe treatment strategy that maximizes aesthetic outcomes without compromising locoregional control.[4]

Takeaways

Question: What are the advantages of an oncoplastic approach to breast reconstruction in patients with breast cancer?

Findings: Oncoplastic surgery allows for more patients with breast cancer to pursue immediate reconstruction while avoiding mastectomy. It is a reliable and safe approach with oncologic advantages, which include improved margin control, re-excision rates, and breast cosmesis. Furthermore, long-term surveillance is not impacted.

Meaning: Oncoplastic surgery for breast cancer is a valuable technique to improve breast contour while achieving optimal oncologic outcomes.

IMPROVED MARGIN CONTROL

OPS provides the opportunity to obtain more generous margins of resection. With BCT, a more generous resection margin is generally avoided to minimize breast deformities. However, given that OPS is associated with larger resection for restoring breast contour and shape, rates of re-excision due to insufficient margins are reduced compared with those for BCT.[10] A meta-analysis by Losken et al composed of 3165 patients reported a

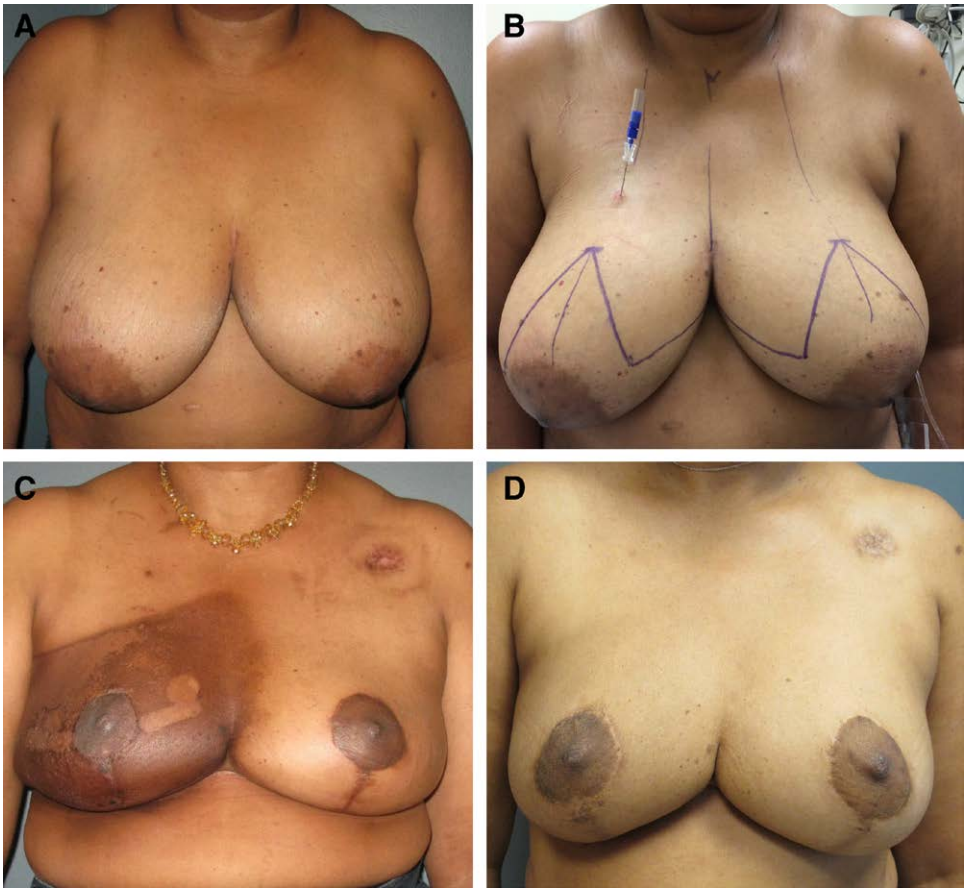

Fig. 1. A 56-year-old woman with a diagnosis of right-sided invasive ductal carcinoma who underwent OPS. A, The patient at the time of diagnosis. B, The patient after wire-localization with preoperative markings. The patient underwent a right partial mastectomy, involving the removal of 230 g of tissue from the right upper quadrant. She then underwent an inferior pedicle oncoplastic reduction, involving the removal of an additional 760 g from around the pedicle. A contralateral reduction was performed, involving the removal of 950 g of tissue. C, D, The patient at 1 month and 3 years after the completion of adjuvant radiation therapy, with good shape and symmetry of the breast.

Table 1. Studies Reporting Re-excision and Positive Margin Rates after OPS

Author, Year	Study Design	Country	No. Cases	Re-excision Rate (%)	Positive Margin Rate (%)
Andre et al[56]	Retrospective	Sweden	458	5.9	
Heeg et al[14]	Retrospective	Denmark	13,185	14.1	
Niinikoski et al[8]	Retrospective	Finland	611	2.8	9.2
Keleman et al[19]	Retrospective	Hungary	350	5.4	
Benjamin et al[57]	Retrospective	USA	172	1.7	
Clough et al[23]	Retrospective	France	350		12.6
Losken et al[58]	Retrospective	USA	353		6.2
Mansell et al[25]	Retrospective	United Kingdom	980		14.4
Carter et al[20]	Retrospective	USA	10,607		5.8
Wijgman et al[59]	Retrospective	The Netherlands	314		22.6
Piper et al[55]	Systematic review	USA	1324	3.5	0-21
Yiannakopoulou et al[60]	Systematic review	Greece	2830		0-36
De La Cruz et al[10]	Systematic review	USA	6011	6	10.8
Crown et al[61]	Retrospective	USA	561	20.1	
Losken et al[12]	Retrospective	USA	222	12	24.1
Losken et al[11]	Meta-analysis	USA	3165	4	12

specimen weight that was four times larger in patients who underwent OPS compared with those who underwent BCT (249 g versus 64 g).[11] Importantly, the positive margin rate was lower in the patients who underwent OPS compared with those who had BCT (12% versus 21%; $P < 0.01$; Table 1).[12] A 2018 meta-analysis by Chen et al reported similar findings with a trend toward lower positive margin rates (RR 0.93, $P = 0.19$) and lower re-excision rates (RR 0.66; $P < 0.01$) in patients who underwent OPS compared with BCT alone.[13] These results were also corroborated in a 2020 retrospective cohort study by Heeg et al, which included 13,185 patents who underwent OPS and BCT, with re-excision rates of 14.1% versus 15.6%, respectively.[14] After controlling for the relevant clinicopathologic factors in the multivariable model, patients who underwent OPS were less likely to undergo re-excision compared with those who underwent BCT [odds ratio 0.80; 95% confidence interval (CI), 0.72–0.88].

OPS has led to decreased rates of completion mastectomy by 5%, when compared with partial mastectomy alone, likely due to improved margin control during the index operation.[10,15] Similarly, a 2022 case series by Baker and colleagues reported 5.3% of patients undergoing OPS required completion mastectomy.[16] Interestingly, some surgeons choose to delay OPS in patients at considerable risk for margin positivity or local recurrence, as tissue rearrangement often makes returning for re-excision more challenging and may impact the overall cosmetic result. Factors that favor delaying reconstruction, at least for the short-term, include increased tumor size, ductal carcinoma in situ, and invasive lobular carcinoma pathology.[17] However, the conversion rate to completion mastectomy after OPS remains fairly low.

In the current era, more patients undergoing OPS receive multimodality therapy, particularly in the neoadjuvant setting. In a 2019 study of 1043 patients with breast cancer who underwent OPS, Gulcelik et al demonstrated no difference in re-excision rates in patients who received neoadjuvant chemotherapy compared with those who had upfront surgery (10.6% versus 8.8%, $P = 0.1$).[18] Keleman and colleagues reported a re-excision rate of 5.4% in patients who underwent OPS.[19] Interestingly, in this study, patients who underwent OPS were more likely to have received neoadjuvant therapy, compared with patients who underwent BCT ($P < 0.01$). This likely reflects the ability of neoadjuvant chemotherapy to downstage tumors, allowing for an expanded pool of OPS-eligible patients.

OPS allows for the ability to obtain wider margin of excision while providing a cosmetic result. It is a reliable alternative to mastectomy given lower rates of re-excision, potentially avoiding a second operation and conversion to mastectomy. However, further studies are needed to better understand the impact of neoadjuvant therapy on margin positivity and rates of re-excision in the context of OPS.

EQUIVALENT ONCOLOGIC OUTCOMES

Existing data demonstrate equivalent long-term oncologic outcomes when comparing patients who undergo OPS with BCT. Although there is a paucity of randomized controlled trial data comparing OPS with BCT, there are several large retrospective cohort studies that have described the short-term and long-term survival outcomes of patients who underwent OPS. In 2016, MD Anderson Cancer Center published a study comparing 9861 patients with primarily T1 and T2 tumors who received either OPS or BCT, demonstrating no difference in 3-year recurrence-free survival (94.6% versus 96.1%, $P = 0.19$) or 3-year overall survival (OS) (95.8% versus 96.8%, $P = 0.16$).[20] In a 2016 Italian study of 193 patients with T2 tumors who underwent OPS, 10-year OS was 87.3%, and 10-year disease-free survival was 60.9%.[21] For patients who underwent OPS, Romics et al reported a 5-year local recurrence rate of 2.7% and a 5-year OS of 93.8% with a median follow-up of 30 months.[22] In a similar study, Clough et al demonstrated a 5-year local recurrence rate of 1.1% with a median follow-up of 55 months.[23] Of note, 27.9% of patients received neoadjuvant therapy. A 2016 systematic review by De La Cruze and colleagues reported a 5-year OS, locoregional recurrence, and distant recurrence rates of 93.4%, 85.4%, and 6%, respectively, with a median follow-up of 50.5 months.[10] A 2019 meta-analysis validated these previous findings, demonstrating

no difference in local recurrence when comparing patients who underwent OPS with those who received BCT (RR 0.86; 95% CI, 0.64–1.16; $P = 0.29$).[24] A European study of 980 patients compared patients who underwent OPS with BCT, showing similar 5-year local recurrence rates (2%, 3.4%, $P = 0.97$).[25] In these studies, it is worth noting patients who underwent OPS typically had larger tumors with more aggressive tumor biology (eg, higher grade). Comparing patients who underwent OPS with BCT, Losken et al determined patients who underwent OPS had larger tumors (OPS 1.5 cm versus BCT 1.1 cm, $P < 0.01$) and had a trend toward lower recurrence rates (OPS 9% versus BCT 13%, $P = 0.34$).[26] Although OPS allows for the ability to obtain a wider margin of resection, and thus improved locoregional control, even in patients with more advanced disease, it is necessary to acknowledge the role of systemic therapy in improving rates of long-term survival.

BREAST REDUCTION AND RISK REDUCTION

Prophylactic bilateral mastectomy serves as an effective breast cancer risk-reducing strategy for women with a genetic predisposition.[27] However, in the sporadic breast cancer population, which comprises the majority of breast cancer patients, contralateral mastectomy has not shown a survival advantage.[28] Furthermore, bilateral mastectomy may not be a desirable option for many women who wish to pursue primary prevention of breast cancer.

Observational studies of women who have undergone reduction mammaplasty indicate that the risk of developing breast cancer decreases proportionally to the volume of tissue removed at the time of surgery.[29,30] In a study of 1245 women who underwent breast reduction surgery, patients who had more than 600 g of tissue removed had a standard incidence ratio for subsequent breast cancer of 0.3 (95% CI, 0.1–0.7), compared with those who had less than 400 g removed, with an incidence ratio of 0.8 (95% CI, 0.4–1.3).[31] In a study of 30,457 Swedish women who underwent breast reduction surgery, Fryzek and colleagues reported a reduced risk of breast cancer compared with the general population (standard incidence ratio = 0.87; 95% CI, 0.83–0.91) and a 30% reduction in breast cancer-specific morality.[32] Similarly, a recent study by Niepel et al found a reduction in breast cancer incidence of 82% in women who underwent breast reduction surgery compared with the general population.[33] Breast reduction may serve as an acceptable alternative for many women who do not wish to pursue more aggressive measures, such as prophylactic mastectomy. The principle of removing additional breast tissue resulting in improved oncologic outcomes, specifically breast cancer risk reduction, seems to hold true for both patients who undergo breast reduction or those who receive OPS.

REDUCTION MAMMAPLASTY AND OCCULT CANCER

The ability to sample additional breast tissue is another benefit of pursuing an oncoplastic approach. In a series of 813 patients who underwent elective contralateral mammaplasty, Petit and colleagues reported an incidence of occult cancer in the contralateral breast of 4.6%.[34] More recently, in patients who underwent reduction mammaplasty for symptomatic macromastia or for symmetry, Carlson reported an incidence of 0.06%–5.45% of occult breast cancer in the contralateral breast.[35] Similarly, a 2020 systematic review composed of patients who underwent reduction mammaplasty found occult carcinoma in the contralateral breast in 3.4% of patients with a history of breast cancer and 0.6% without a prior history of breast cancer.[36] While the necessity to perform preoperative breast imaging and to evaluate for appropriate preoperative risk stratification remains to identify patients at higher-risk for breast cancer, OPS allows for the ability for further pathological examination of breast reduction specimens.

IMPACT OF OPS ON MULTIMODALITY THERAPY

The treatment of breast cancer requires a multidisciplinary approach, encompassing systemic therapy, radiation therapy, and surgery. When pursuing OPS, the treatment team must carefully consider the impact of neoadjuvant chemotherapy, the risk of postoperative complications, and delay subsequent to adjuvant therapy, and the ability to deliver appropriate boost radiation to the surgical field is crucial, especially after OPS.

Neoadjuvant Chemotherapy

Neoadjuvant systemic therapy may be indicated for women with axillary disease, a larger tumor burden, triple negative receptor status, or human epidermal growth factor receptor (HER2+) cancers. Surgery is typically performed 2–4 weeks after completion of chemotherapy. Multiple, larger-scale studies have not demonstrated an association of neoadjuvant chemotherapy with major postoperative complications in patients who receive BCT.[37,38] Although limited data are available regarding the safety of OPS after the receipt of neoadjuvant chemotherapy, a 2021 retrospective review of 122 patients who received neoadjuvant chemotherapy and OPS found that after adjustment of the relevant clinicopathologic risk factors, neoadjuvant chemotherapy was not associated with an increased risk of complications or delayed receipt of adjuvant therapy.[39]

Radiation Therapy

Concerns have been raised regarding the possible delay of adjuvant radiation therapy after OPS due to the potential risk of postoperative complications. Complications can include cellulitis, delayed wound healing, seroma, hematoma, abscess formation, skin necrosis, and wound dehiscence, though only a small percentage of patients necessitated operative intervention.[40] Although the reported complication rate after OPS is 20%, only 8% experienced delays to adjuvant radiation therapy.[41] When postoperative complications do occur, Kapadia et al reported that there was a delay in the initiation of adjuvant radiation of 74 days, compared with 54 days in the noncomplication group ($P < 0.01$).[42] Independent patient-specific predictors associated with complications, and thus,

a delay to receiving adjuvant treatment, include a higher body mass index and older age. These results underscore the need for preoperative risk stratification, optimization, and careful selection of OPS candidates, given that a delay to radiation of more than 3 months after surgery can lead to increased cancer-specific mortality.[43]

In a subset of high-risk breast cancer patients, additional boost radiation localized to the tumor cavity has been shown to decrease ipsilateral tumor recurrence.[44] With OPS, however, there can be variations in the degree of tissue and glandular rearrangement based on surgical technique, and the feasibility of delivering boost radiation therapy has been debated. Gladwish et al determined that the ability to deliver boost radiation was not affected when OPS was pursued, compared with BCT.[45] To assist with accurate targeting for the delivery of boost radiation, reliable placement of surgical clips in the resection bed is critical.[46] As a result, emerging technologies can help facilitate consistent identification of the resection cavity. Preliminary studies of three-dimensional bioabsorbable tissue markers placed at the time of surgery, including OPS, have shown promise with successful identification of the resection bed in preparation for boost radiation, in addition to low postoperative surgical-site infection rates and preserved cosmetic outcomes.[47,48] Lastly, a multidisciplinary debrief between plastic surgeons and radiation oncologists has been shown to improve communication and understanding of relevant anatomic changes after reconstructive surgery as patients proceed with radiation therapy.[49–51]

SURVEILLANCE

There are no specific guidelines for patients who undergo breast OPS versus BCT. Current National Comprehensive Cancer Network guidelines recommend annual mammograms for surveillance of breast cancer patients after BCT.[52] Previously, Losken and colleagues reported a trend towards slightly longer times for patients who underwent OPS to reach mammographic stabilization compared with BCT (25.6 months versus 21.2 months, $P = 0.23$), which may result in additional biopsies.[53] However, more recent series have concluded that patients who undergo OPS do not have increased imaging or biopsy requirements. Crown et al determined there was no difference in the need for additional mammograms when comparing patients who underwent OPS with those who received BCT (25.9% versus 26.7%, $P = 0.91$).[54] Similarly, Piper and colleagues demonstrated no difference in abnormal mammographic findings when comparing patients who underwent OPS with age-matched BCT patients at 6 months, 2 years, and 5 years postoperatively ($P > 0.05$), and similar biopsy rates (24% versus 18%, $P = 0.46$).[55] A larger study of 422 patients by Crown et al reported similar findings with no difference in additional imaging requirements (25.9% versus 26.7%, $P = 0.91$).[54] This suggests that OPS does not impact the ability to detect disease recurrence. In fact, the need for biopsy was two fold lower in patients who underwent OPS patients compared with those who underwent BCT (9.3% and 18.9%, $P < 0.01$). Thus, oncoplastic techniques have not been shown to reduce the sensitivity of screening or diagnostic mammograms. This is supported by the fact that both qualitative (eg, architectural distortion, cysts, calcifications) and quantitative (eg, breast density scores) mammographic findings are similar in patients who undergo either OPS or BCT.[53,55] In summary, manipulation and reduction of breast tissue using an oncoplastic approach does not seem to interfere with adequate postoperative imaging surveillance.

CONCLUSIONS

In the past decade, OPS has emerged as a valuable technique to improve breast contour while achieving optimal oncologic outcomes in patients with breast cancer. Benefits extend beyond improved cosmesis. Patients previously deemed unsuitable for BCT now have the ability to undergo OPS to mitigate breast deformities, especially after a clinical response to neoadjuvant therapy. OPS also allows for breast preservation with a larger margin of excision. OPS is oncologically safe, with similar rates of recurrence-free survival and OS, though a randomized controlled trial is warranted to validate these findings. Although postoperative complications in the setting of multimodality cancer treatment can delay the initiation of adjuvant radiation, the ability to successfully deliver boost radiation is not affected by surgical technique. Furthermore, OPS does not impact mammographic sensitivity or the ability to proceed with appropriate cancer surveillance. Continued collaboration across specialties is crucial to improve the care of breast cancer patients.

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DISCLOSURES

Dr. Losken is a consultant for RTI Surgical. All the other authors have no financial interest to declare in relation to the content of this article.

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