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Oncoplastic Breast Reduction: A Systematic Review of Postoperative Complications

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Background: Breast-conserving therapy with oncoplastic reduction is a useful strategy for partial mastectomy defect reconstruction. The most recently published systematic review of oncoplastic breast reduction outcomes from 2015 showed wound dehiscence in 4.3%, hematoma in 0.9%, infection in 2.8%, and nipple necrosis in 0.9% of patients. We performed a systematic review of oncoplastic breast reduction literature, comparing outcomes and complication rates reported over the past 8 years.

Methods: Studies describing the use of oncoplastic breast reduction and discussion of postoperative complications were included. The primary outcome assessed was the postoperative complication rate; secondary outcomes analyzed were rates of margin expansion, completion mastectomy, and delays in adjuvant therapy due to complications.

Results: Nine articles met inclusion criteria, resulting in 1715 oncoplastic breast reduction patients. The mean rate of hematoma was 3%, nipple necrosis was 2%, dehiscence was 4%, infection was 3%, and seroma was 2%. The need for re-excision of margins occurred in 8% of patients, and completion mastectomy in 2%. Finally, delay in adjuvant treatment due to a postoperative complication occurred in 4% of patients.

Conclusions: Oncoplastic breast reduction is an excellent option for many patients undergoing breast-conserving therapy; however, postoperative complications can delay adjuvant radiation therapy. Results of this systematic literature review over the past 8 years showed a slight increase in complication rate compared to the most recent systematic review from 2015. With increased popularity and surgeon familiarity, oncoplastic breast reduction remains a viable option for reconstruction of partial mastectomy defects despite a slight increase in complication rate.
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INTRODUCTION

Oncoplastic breast-conserving surgery (OBS) continues to grow in popularity as a breast-conserving option due to its ability to maintain clear margins in cancer extirpation while maintaining excellent cosmetic results.[1,2] These surgical techniques involve volume displacement and replacement with breast reshaping after neoplasm excision.[3] There are numerous benefits to breast-conserving management compared to mastectomy, including decreased operative time, improved aesthetic outcomes, limited side effects of surgery, and improved patient satisfaction.[4,5]

These benefits are amplified in women with macromastia because breast reconstruction following skin-sparing mastectomy in women with large ptotic breasts is associated with higher complication rates than in patients with sternal notch to nipple distance less than 26 cm or excised breast mass less than 750 g.[6] Oncoplastic breast reduction, combining partial mastectomy with a bilateral reduction mammaplasty, is an excellent option for patients with macromastia due to its decreased postoperative morbidity, fewer revision procedures, and maintenance of satisfactory cosmetic results as compared to total reconstruction.[7] This commonly involves a Wise pattern skin excision combined

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with a vascular pedicle designed according to the location of the neoplasm to ensure viability of the nipple-areolar complex.

There are drawbacks to oncoplastic breast reduction including concerns regarding delays in adjuvant therapy due to postoperative complications with a resultant negative impact on a patient's oncologic outcome. A prior systematic review of postoperative complications after oncoplastic breast reduction published in 2015 showed a 4.6% rate of wound dehiscence, 0.9% nipple necrosis, 2.8% infection rate, 0.6% seroma rate, need for re-excision of margins in 3.5% of patients, and completion mastectomy in 3.7% of patients.[1]

The goal of this systematic review was to examine postoperative results of patients undergoing pedicle-based oncoplastic breast reduction to evaluate trends in complications over time. We also sought to examine the need for re-excision of margins, completion mastectomy, and rates of delay in adjuvant radiation or chemotherapy due to the presence of postoperative complications.

Takeaways

Question: What is the rate of postoperative complications following oncoplastic breast reduction, and how do these complications affect adjuvant treatment timing?

Findings: A systematic review of postoperative complications following oncoplastic breast reduction from 2015 to 2022 showed a 3% rate of hematoma, 2% nipple necrosis, 4% dehiscence, 3% infection, and 2% seroma. Re-excision of margins occurred in 8% of patients, completion mastectomy in 2%, and delay in adjuvant treatment due to postoperative complication in 4% of patients

Meaning: The overall postoperative complication rate of oncoplastic breast reduction is low; however, a postoperative complication can delay adjuvant therapy.

METHODS

Literature Search

Studies describing postoperative complications of oncoplastic breast reduction were identified from PubMed, Google Scholar, and OVID databases in July 2022. The search terms "oncoplastic breast reduction," "oncoplastic breast reduction AND complications," "oncoplastic reduction mammaplasty," and "oncoplastic reduction mammaplasty AND complications" were used to identify articles published after 2015. A title review was then performed to select articles that would subsequently undergo abstract review, including articles reporting postoperative complications. These abstracts were reviewed to include all reports on postoperative complications of patients after oncoplastic reduction mammaplasty between January 2015 and July 2022. The methods sections of the articles in review were critically analyzed by three independent reviewers to ensure patients had undergone true reduction mammoplasty. This involved evaluation of the description of the pedicle within the operative details. Exclusion of articles was performed for published articles including the same patient cohort, articles describing "oncoplastic breast surgery" without mention of oncoplastic breast reduction or pedicle selection, data without distinction between reduction cases and oncoplastic breast surgery cases, studies published before 2015, and studies lacking data on postoperative complication rates. After the final analysis and implementation of all exclusion criteria, nine articles were included for data analysis.[4,8]

Analysis of Outcomes

Patient demographics, postoperative complications, follow-up duration, delay in adjuvant therapy due to complications, rates of re-excision for involved margins, and rates of completion mastectomy were collected by an independent statistician. Patient demographics collected included age, mean body mass index, active smoking status, and presence of diabetes mellitus as a comorbidity. Specific complications were evaluated per breast and included hematoma, nipple-areolar complex necrosis, wound dehiscence, infection, and seroma. The rate of re-excision of margins and completion mastectomy for positive margins on postoperative pathology analysis were separately evaluated.

The following revision procedures and minor wound healing complications were excluded from analysis: delayed wound healing, T-junction necrosis, revision procedures (scar revision, fat grafting, and revision mastopexy), wound breakdown requiring follow-up, mild wound breakdown requiring debridement in the clinic, nipple sensation, redness/lymphedema, and triple point ulceration.

We performed an inverse variance-weighted random-effects systematic review of proportions for the primary and secondary outcomes in oncoplastic breast reduction. Between-study variance was estimated via restricted maximum likelihood, and the Hartung-Knapp method was used to obtain the 99% confidence interval (CI) of the pooled odds ratio for the random-effects analysis.[9] The analysis was performed using R version 4.2.1 with the meta package, using the inverse variance method.[10]

RESULTS

Nine articles were identified that met inclusion criteria, representing 1715 patients (Table 1) with surgery occurring between 1995 and 2020.[11–19] Reported mean follow-up ranged from 9.4 to 84 months. Mean patient age ranged from 51.9 to 59.6 years and mean body mass index had a range of 24.2–33.5 kg/m^2 (Table 2). Seven of the nine articles, representing 888 cases, reported diabetes mellitus as a comorbid condition with prevalence ranging from 4.2% to 16.4%. Six articles, representing 927 cases, reported on radiotherapy with a range of 86%–100% of patients receiving neoadjuvant or adjuvant radiation.

Postoperative Complications

Eight articles, representing 1691 patients, reported postoperative complications (Table 2). Hematoma was reported in all eight of these articles, with a rate of 3% (99% CI: 2%–4%) (Fig. 1). Nipple or nipple-areolar complex necrosis was reported in six papers, representing

Table 1. Studies Included in Systematic Review

Study	Year	Patients	Mean Follow-up (mo)	Mean Age (y)	Mean Body Mass Index (kg/m²)	Reports Delay in Adjuvant Therapy	Reports Re-excision or Completion Mastectomy
Acea Nebril[11]	2017	170	84	52.5	26.5	No	Yes
Brown[12]	2021	528	46.8	55	33.5	No	Yes
Crown[13]	2018	71	32.1	59.6	31.9	No	Yes
Ettinger[14]	2016	24	-	57	32.3	Yes	Yes
Kelemen[15]	2018	190	43.9	56	24.2	No	Yes
Marano[16]	2022	62	9.4	51.9	29.2	Yes	No
Mattingly[17]	2017	59	-	55.6	32	No	Yes
Pawlak[18]	2022	198	12	54.7	29.2	Yes	Yes
Schaverien[19]	2020	413	59.5	55.1	32.5	Yes	Yes

Table 2. Postoperative Complications of Patients Included in Systematic Review

Study	Patients/ Breasts	Hematoma	Nipple Necrosis	Dehiscence	Infection	Seroma	Re-excision of Margins	Completion Mastectomy
Acea Nebril[11]	170	4	4	—	1	3	15	5
Brown[12]	528	16	—	14	8	3	41	29
Crown[13]	71/139	2*	1*	—	2*	1*	4	2
Ettinger[14]	24	—	—	—	—	—	0	0
Kelemen[15]	190/380	6*	5*	10*	7*	3*	11	2
Marano[16]	62	4	3	5	3	2	—	—
Mattingly[17]	59	4	1	2	1	5	4	1
Pawlak[18]	198	2	—	8	6	7	19	0
Schaverien	413	10	2	18	28	10	30	0

*Reported per breast.

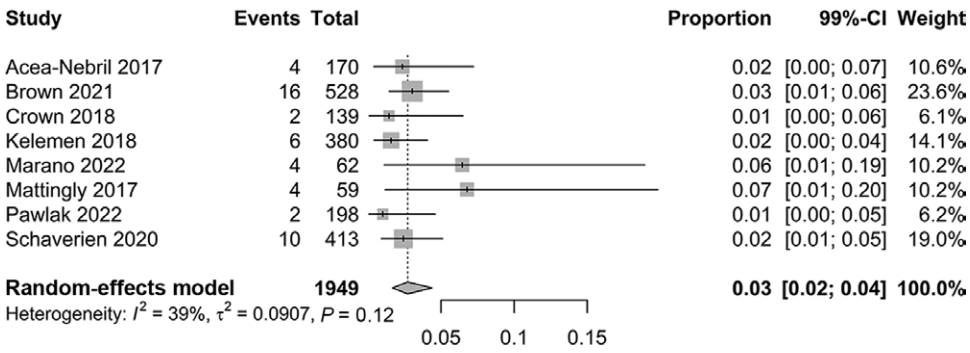

Fig. 1. Proportions for hematoma. We performed a random-effects meta-analysis on summary data from the eight studies that reported hematoma postoperative complications. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the eight studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

965 patients, and occurred in 2% (99% CI: 1%–4%) (Fig. 2). Wound dehiscence was reported in six papers, representing 1450 patients, with a rate of 4% (99% CI: 2%–5%) (Fig. 3). Finally, both infection and seroma were reported in all eight articles, with rates of 3% (99% CI: 1%–5%) and 2% (99% CI: 1%–5%), respectively (Figs. 4 and 5).

Re-excision for Positive Margins and Completion Mastectomy

Re-excision for positive margins on pathologic analysis and completion mastectomy rates were reported in eight articles, representing 1653 patients. The mean rate of re-excision for positive margins was 8% (99% CI: 6%–10%) and the rate of completion mastectomy was 2% (99% CI: 1%–5%) (Figs. 6 and 7). Most articles defined the need for margin expansion as "positive margins" on permanent pathology; however, Crown et al and Kelemen et al required margins of 2 mm on pathologic analysis to preclude re-excision.[13,15]

Delay in Adjuvant Therapy

A delay in adjuvant treatment due to a postoperative complication was reported in four articles, representing 646 patients. Two of these articles did not report what was considered a delay in adjuvant treatment; however, Pawlak et al defined delay as 3 months after surgery, and Schaverien et al defined delay as 8 weeks postoperatively.[18,19] Delay in

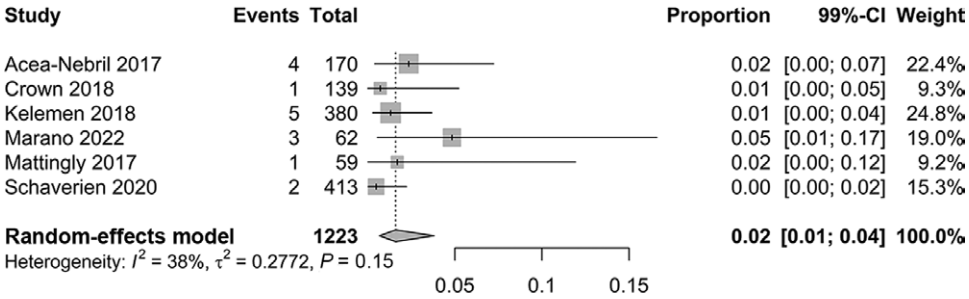

Fig. 2. Proportions for nipple or nipple-areolar complex necrosis. We performed a random-effects meta-analysis on summary data from the six studies that reported nipple or nipple-areolar complex necrosis postoperative complications. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the six studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

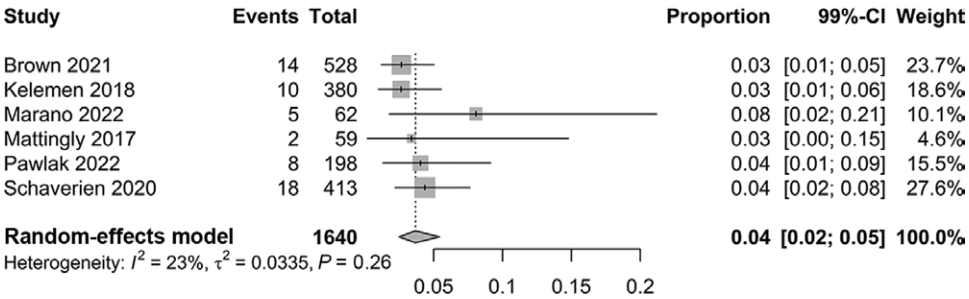

Fig. 3. Proportions for wound dehiscence. We performed a random-effects meta-analysis on summary data from the six studies that reported wound dehiscence postoperative complications. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the six studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

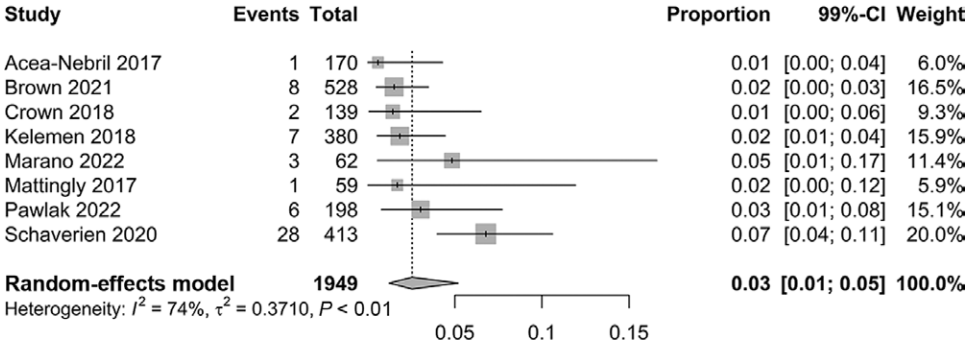

Fig. 4. Proportions for infection. We performed a random-effects meta-analysis on summary data from the eight studies that reported infection postoperative complications. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the eight studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

adjuvant radiation or chemotherapy occurred in 4% of patients (99% CI: 2%–7%) (Fig. 8).

DISCUSSION

The benefits of oncoplastic breast reduction have been well described in the surgical literature as a reliable reconstructive technique after breast-conserving therapy with low rates of postoperative complications.[20] When comparing OBS to standard breast-conserving surgery, the addition of plastic surgical techniques has shown lower rates of re-excision, improved breast cosmesis, and lower postoperative complications.[21,22] Additionally, OBS results in fewer revision procedures, decreased postoperative

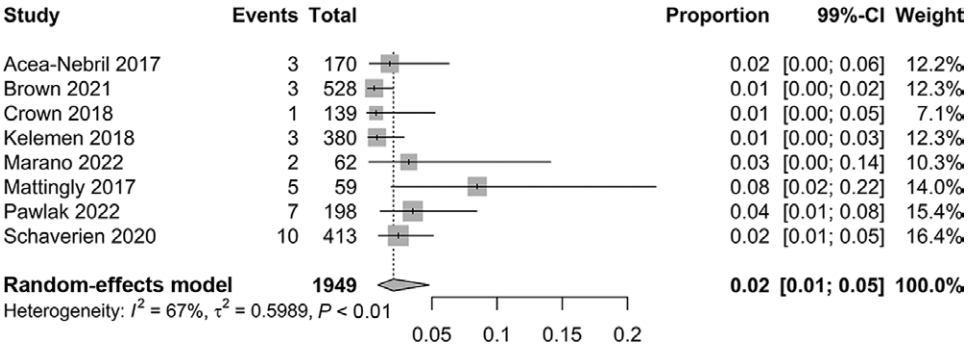

Fig. 5. Proportions for seroma. We performed a random-effects meta-analysis on summary data from the eight studies that reported seroma postoperative complications. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the eight studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

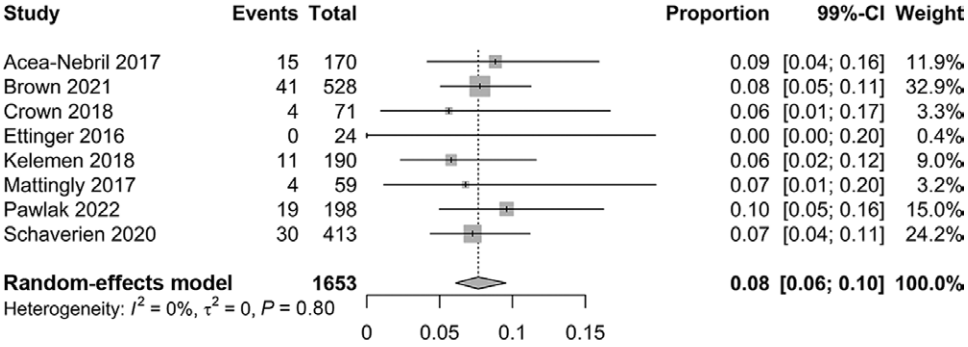

Fig. 6. Proportions for re-excision for positive margins on pathologic analysis. We performed a random-effects meta-analysis on summary data from the eight studies that reported re-excision for positive margins on pathologic analysis. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the eight studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

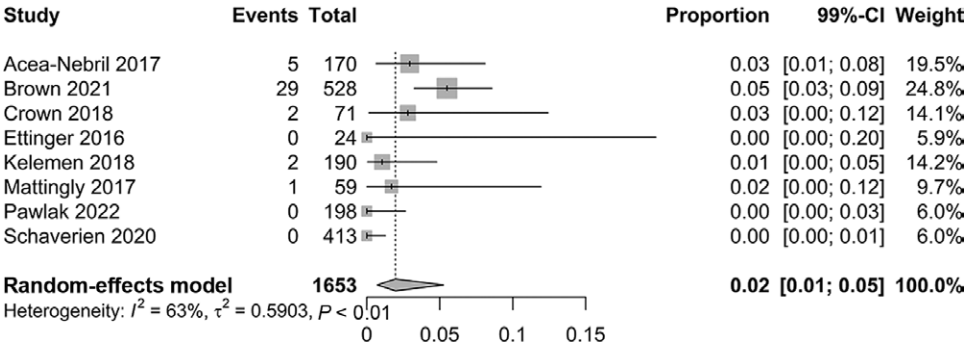

Fig. 7. Proportions for completion mastectomy. We performed a random-effects meta-analysis on summary data from the eight studies that reported completion mastectomy. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the eight studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

morbidity, and prolonged satisfaction with cosmetic results as compared to mastectomy with total breast reconstruction.[7]

Despite this, trepidation persists with concerns regarding alteration in the orientation of breast parenchyma after oncoplastic breast reduction limiting the ability to re-excise

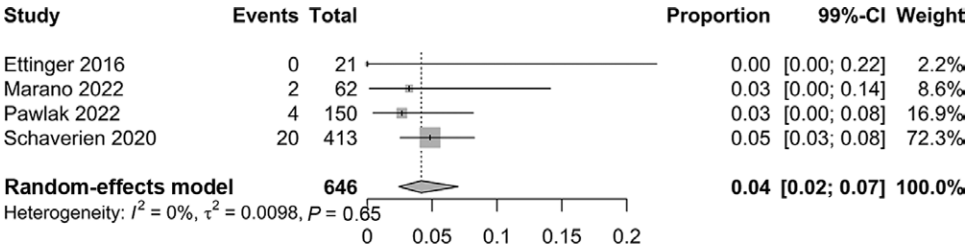

Fig. 8. Proportions for delay in adjuvant treatment due to a postoperative complication. We performed a random-effects meta-analysis on summary data from the four studies that reported a delay in adjuvant treatment due to a postoperative complication. The boxes represent estimated proportions, with the sizes of the boxes indicating the inverse variance of the four studies, and the horizontal lines represent their 99% CIs. The diamond represents the pooled proportion. The width of the diamond represents the width of the 99% CI of the pooled proportion.

margins and delays in adjuvant radiation and chemotherapy secondary to postoperative complications. This systematic review sought to characterize trends in complication profiles after oncoplastic reduction in the recent literature as well as delineate rates of delay in adjuvant therapy due to the presence of a postoperative complication.

The most recent systematic review by Piper et al describing postoperative outcomes after oncoplastic breast reduction, published in 2015, included 1312 patients from 17 separate articles.[1] Postoperative complications examined included hematoma in 0.9% of patients, nipple necrosis in 0.9%, dehiscence in 4.6%, infection in 2.8%, and seroma in 0.6%. These values are comparable to the complication rates seen which showed a hematoma rate of 3%, nipple necrosis in 2%, dehiscence in 4%, infection in 3%, and seroma in 2%.

Comparison of data must also include an analysis of the need for margin expansion or completion mastectomy after the final pathologic analysis of the resected specimen. The prior Piper et al review showed a 3.5% rate of re-excision of margins and a 3.7% completion mastectomy rate. Our review showed re-excision of margins in 8% of patients and completion mastectomy in 2%.

These postoperative complications carry negative secondary effects including increased cost, the need for reoperation or hospitalization, and the possibility of delays in adjuvant therapy, which carries an unknown effect on an individual patient's oncologic prognosis. The standard time frame for initiation of adjuvant RT is within 3 months after surgery, and delays greater than 3 months have been associated with higher overall mortality and cancer-specific mortality as well as poorer local control.[23,24] Additionally, a delay in adjuvant chemotherapy of greater than 120 days from initial diagnosis to initiation of chemotherapy has shown association with decreased overall survival.[25]

It is well described that ipsilateral breast recurrence, the occurrence of distant metastases, and breast cancer-specific survival rates are all adversely affected by postoperative delays in initiating any postsurgical breast cancer treatment, including radiation therapy (RT), antiestrogen therapy, and chemotherapy.[26–37] Recently, these long-held tenets have been questioned within certain subsets of patients.[38,39] Delays in adjuvant treatments after mastectomy appear less adverse than similar delays after OBS.[27,28,32–35] Moreover, the effect delay has on these outcomes also seems to be stratified by tumor-specific biology; least pronounced with noninvasive ductal carcinoma in situ and more pronounced with aggressive triple-negative invasive breast cancers.[26–30,37] In 1323 patients with ductal carcinoma in situ treated with OBS, initiation of adjuvant RT within 8–12 weeks of surgery resulted in 5.8% of 5-year and 13% of 10-year ipsilateral breast recurrence, respectively. However, when adjuvant RT was started after 12 weeks, ipsilateral breast recurrence increased to 8.8% and 23% at 5 and 10 years, respectively.[26] Similar findings are reported in the analysis of invasive cancers of all biologic subtypes.[31–34] In a National Cancer Database query of 186,650 women undergoing breast conservation therapy for stage I–III invasive breast cancers, a delay of greater than 8 weeks to initiation of RT after surgery led to a decreased overall survival of 11%.[32] These results are also true for chemotherapy delays after surgery, with the effect being more pronounced in the OBS group than in the mastectomy group.[35–37] Mastectomy patients show no difference in 10-year survival for chemotherapy delay greater than 30 days after surgery. In the OBS group, 10-year survival was 84.4% when chemotherapy was initiated within 30 days but decreased to 76.9% when initiated greater than 30 days postoperatively.[35]

There are several limitations of this review, primarily due to the limitations of the individual studies included. Included reports were retrospective case series, and the majority did not include control groups. Additionally, there was variability in the mean follow-up duration of patients with some studies having limited postoperative follow-up. Consolidations of complications within individual articles were an additional limitation; for example, in some included articles, hematoma and seroma were grouped together as a single complication category. In these cases, the complication was included in both the hematoma and the seroma complication rates in our data analysis, as it was not possible to determine which of the two outcomes had occurred. Moreover, not all papers contained information for every postoperative outcome. In particular, we were able to use the Ettinger et al paper[14] only in analyses of the secondary outcomes (ie, re-excision for positive margins, completion mastectomy, and delay in adjuvant treatment) as they only listed postoperative complications by the patient, not by breast.

Although prior studies have not shown a significant difference in postoperative complication rates based on the

pedicle type or skin incision pattern of oncoplastic breast reductions, the inability to include this variable in our analysis remains a limitation of this review.[40] Of the nine articles included in this review, five included information regarding the skin excision pattern performed, and four included pedicle selection. However, statistical analysis of complication rates associated with the differing pedicles and skin excision patterns was not included, precluding the ability to include this information within this systematic review.

Inconsistent reporting of postoperative complications remains a limitation of all retrospective systematic analyses, because what constitutes a complication is subject to interpretation by individual authors. For this reason, delayed wound healing was excluded from analysis due to the wide variation in presentations within this broad category of complication. Lack of inclusion of postoperative aesthetic outcomes is another limitation of this review. Included articles did not include data on patient or physician satisfaction with final aesthetic outcome; however, this is an area for future study. Additionally, lack of standardization on what pathologic margin necessitates re-excision or completion mastectomy is a limitation of this review, as two of the eight articles reporting need for margin expansion required a 2-mm margin, whereas the remaining six needed only negative margins. Finally, the inability to quantify the length of delay of adjuvant therapy is another limitation of this study, and future considerations include review of duration of delays in adjuvant therapy and the corresponding oncologic outcomes of those experiencing a delay.

CONCLUSIONS

Oncoplastic breast reduction remains a viable option for patients undergoing breast-conserving therapy and the present study supports the continued use of this procedure. We sought to identify the rates of postoperative complications by performing a systematic review of studies published between 2015 and 2022. This showed a hematoma rate of 3%, nipple necrosis of 2%, dehiscence in 4%, infection in 3%, and seroma in 2% of breasts. Margin expansion occurred in 8% of patients, completion mastectomy in 2%, and delay in adjuvant treatment due to postoperative complication in 4% of patients. For reconstruction of partial mastectomy defects, this technique offers effective oncologic and cosmetic results that will continue to be refined with ongoing outcome reporting. With increased popularity and surgeon familiarity, oncoplastic breast reduction remains a practical option in reconstruction after breast-conserving surgery.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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