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ORIGINAL ARTICLE
Breast

Time to Radiation after Oncoplastic Reduction versus After Lumpectomy

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Background: Prior studies contrasting oncoplastic reduction (OCR) to traditional lumpectomy have validated oncoplastic reduction surgery with similar survival and oncological outcomes. The purpose of this study was to evaluate if there was a significant difference in the time to initiation of radiation therapy after OCR in comparison with the standard breast-conserving therapy (lumpectomy).

Methods: The patients included were from a database of breast cancer patients who all underwent postoperative adjuvant radiation after either OCR or lumpectomy at a single institution between 2003 and 2020. Patients who experienced delays in radiation for nonsurgical reasons were excluded. Comparisons were made between the groups in the time to radiation and complication rates.

Results: A total of 487 patients underwent breast-conserving therapy, with 220 having undergone OCR and 267 lumpectomy patients. There was no significant difference in days to radiation between patient cohorts (60.5 OCR, 56.2 lumpectomy, $P = 0.059$). There was a significant difference in the number of complications between OCR and lumpectomy patients (20.4% OCR, 2.2% lumpectomy, $P < 0.001$). However, of patients who had complications, there was no significant difference in the number of days to radiation (74.3 OCR, 69.3 lumpectomy, $P = 0.732$).

Conclusions: Compared with lumpectomy, OCR was not associated with an increased time to radiation but was associated with higher complications. Statistical analysis did not reveal surgical technique or complications to be independent, significant predictors of increased time to radiation. Surgeons should be aware that although complications may remain higher in OCR, this does not necessarily translate to delays in radiation. *(Plast Reconstr Surg Glob Open 2023; 11:e4970; doi: 10.1097/GOX.0000000000004970; Published online 10 May 2023.)*

INTRODUCTION

Breast cancer is the most common cancer for women throughout the world, and over 300,000 women are diagnosed with it in the USA each year.[1] Conventional breast conserving therapy usually refers to lumpectomy, followed by radiation therapy. Breast conserving therapy is the standard therapy for women with early-stage breast cancer and indications have continued to expand, allowing for the resection of larger lesions with an excellent overall survival rate equal to that of traditional mastectomy.[2–4] However, a major limitation of lumpectomy is poor aesthetic outcome with 20%–30% of patients with residual deformity after surgery.[5]

Oncoplastic breast reduction surgery was first described in the mid-1990s. It combines oncologic principles of cancer resection with the aesthetics of breast reduction.[6] The goal of oncoplastic reduction surgery (OCR) is to maximize aesthetic outcomes and broaden the indications for lumpectomy, allowing patients with larger or poorly located tumors with larger breasts to have improved aesthetic outcomes.[7] Advancements in surgical techniques have allowed more tissue to be preserved during the removal of malignant tumor. Such techniques have provided more options for reconstruction. Although specific treatments and approaches may vary for OCR, the underlying concepts of the procedure include removal of

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the cancer with clear margins, immediate reconstruction of the breast, and balancing procedures on the contralateral breast to preserve symmetry.[8]

With the additional surgery of the immediate breast reconstruction in OCR, the concern with OCR is the higher risk for postoperative complications, resulting in a potentially increased time to initiation of adjuvant radiation therapy.[7,9] Adjuvant radiation therapy is a key component of breast conserving therapy, as it has demonstrated a decrease in local recurrence by 50%–60%.[10] The optimal time to initiation of radiation, however, is unclear and is often institutional, varying from 4 to 10 weeks.[7]

Prior isolated studies contrasting OCR to traditional lumpectomy have validated the overall safety of OCR with similar survival and oncological outcomes.[9,11,12] However, to our knowledge, no study has evaluated the relationship between complications of partial mastectomy without an oncoplastic approach and the effect on time to radiation or directly compared lumpectomy and OCR in terms of the time to initiation of radiation therapy. The purpose of this study was to evaluate if there was a significant difference in time to initiation of radiation therapy after OCR in comparison with the standard lumpectomy, and how complications may affect timing.

Takeaways

Question: Is there a difference in time to radiation between oncoplastic surgery and lumpectomy, including in patients with complications?

Findings: In a retrospective cohort study of 487 patients dating back nearly 20 years, the authors of the present study did not find a significant difference in time to radiation between oncoplastic reduction and lumpectomy. Statistical analysis did not reveal complications or surgical technique to independently predict increased time to radiation.

Meaning: Patients and surgeons may safely proceed with oncoplastic reduction without fearing that it may worsen the prognosis by delaying time to radiation.

MATERIALS AND METHODS

This study was approved by our institutional review board. The patients included were from a database of all breast cancer patients who all received postoperative adjuvant radiation after undergoing either OCR or lumpectomy at a single institution between 2003 and 2020. All patients had a diagnosis of breast cancer and received subsequent radiation therapy after either lumpectomy or OCR.

Patients were excluded if they received adjuvant chemotherapy or underwent radiation at an outside facility, or experienced delays for nonsurgical reasons. Patient demographic variables included age, body mass index, and comorbidities (smoking, hypertension, diabetes mellitus).

Patients were divided into two groups: patients who underwent lumpectomy or OCR. The totaled number of days to initiation of radiation therapy was started at postoperative day zero to the day of initiation of radiation treatment. The primary endpoint of interest to be included in this series was the time to radiation in the two groups. Additionally, the rate of postoperative complications between the two groups, and effect on time to radiation treatment was evaluated. Major complications included any urgent/emergent return to the operating room or unanticipated readmission. All other complications were considered minor. Delayed wound healing was defined as superficial dehiscence of the surgical site requiring multiple office dressing changes and/or debridement. Infection was defined as a surgical incision with increasing erythema, purulence, or tenderness requiring antibiotics and/or drainage. Breast seroma/hematoma was defined as fluid/blood collections that required aspiration in clinic or the operating room. Nipple necrosis was defined as clinical evidence of full-thickness necrosis requiring multiple dressing changes and/or debridement.

In addition to information from the original procedure, data points queried included patient demographics, indications for surgery, and complications. Demographic factors, time to radiation, and surgical outcomes were analyzed by chi-square (categorical variables) or independent *t* tests (categorical and continuous) with significance set at a *P* value less than 0.05. A multiple variable linear regression analysis was performed with the dependent variable of time to radiation (days). Demographic factors, complications, surgical technique, and tumor pathology were included in the model as independent variables. All statistical analysis was conducted using the IBM SPSS Statistics 27.0 (IBM Corp., Armonk, N.Y.).

SURGICAL TECHNIQUE

OCR and lumpectomy techniques were standardized throughout the study period. Tumor resection and oncoplastic reconstruction were performed by the two-team approach involving both the breast and plastic surgeon. Re-excisions were also performed with both surgeons. Specific type of reduction was dependent on multiple factors, including tumor location, tumor defect, and breast size. All patients who underwent OCR received contralateral balancing procedures on the other breast to preserve symmetry.

RESULTS

Patient Demographics

A total of 487 patients underwent breast surgery, with 220 having an oncoplastic procedure and 267 undergoing lumpectomy. There was a significant difference in age at the time of surgery, with younger patients undergoing oncoplastic surgery (56.3 compared with 60.2 in breast-conserving, $P < 0.001$). Patients undergoing lumpectomy had a significantly lower BMI (29.1 compared with 33.6 in oncoplastic, $P < 0.001$). Oncologic details were similar between cohorts. There were significantly higher rates of adjuvant chemotherapy among patients undergoing

Table 1. Patient Demographics

	Oncoplastic (n = 220)	Lumpectomy (n = 267)	*P*
Age	56.3 ± 10.5	60.2 ± 11.3	<0.001
BMI	33.6 ± 7.6	29.1 ± 6.7	<0.001
Smoking	12 (5.4)	11 (4.1)	0.489
Diabetes	22 (9.9)	27 (10.1)	0.928
Hypertension	112 (50.2)	94 (35.2)	<0.001
Oncologic details			
Tumor stage			
Tx	2 (1.0)	0 (0.0)	0.204
Tis	57 (25.9)	68 (25.5)	0.912
T0	2 (1.0)	1 (0.0)	0.453
T1	103 (47.0)	137 (51.3)	0.324
T2	47 (21.4)	49 (18.4)	0.303
T3	8 (3.6)	8 (3.0)	0.693
T4	1 (0.0)	4 (1.5)	0.384
Nodal stage			
Nx	31 (14.0)	7 (2.6)	<0.001
N0	150 (68.1)	219 (82.0)	0.006
N1	31 (14.0)	34 (12.7)	0.661
N2	8 (3.6)	7 (2.6)	0.514
Adjuvant chemotherapy	13 (5.9)	36 (13.5)	0.006

lumpectomy (13.5% compared with 5.9% in oncoplastic, $P = 0.006$; Table 1).

Time to Radiation

There was no significant difference in the mean and median days to radiation between patients (Fig. 1, Table 2). The mean time to radiation was 60.5 days in the oncoplastic group and 56.2 days in the lumpectomy group, with no statistical difference ($P = 0.059$).

Complications

There was a significant difference in the number of complications between oncoplastic and lumpectomy cohorts (20.4% oncoplastic versus 2.2% lumpectomy, $P < 0.001$). There was no significant difference in major complications between cohorts. There was a significantly higher rate of minor complications among patients undergoing lumpectomy (18.2% oncoplastic versus 1.9% lumpectomy, $P < 0.001$). The most common complications were delayed wound healing, followed by infection, seroma, hematoma, and nipple necrosis. However, among patients with complications, there was no significant difference in time to radiation, with 74.3 days in the oncoplastic group and 69.3 days in the lumpectomy group (Fig. 2, Table 3).

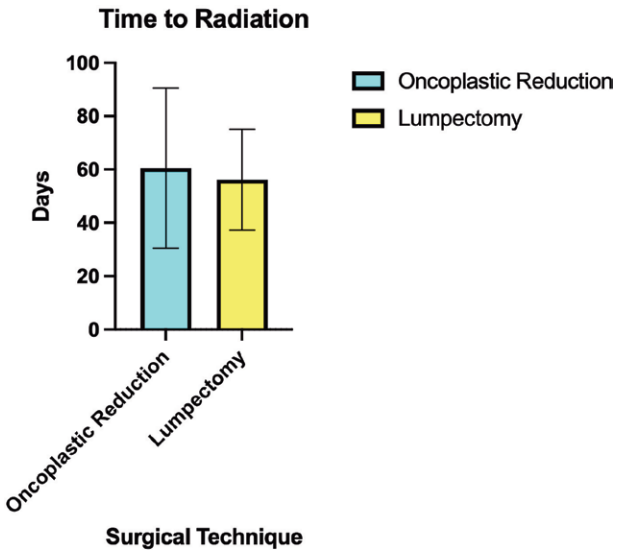

Fig. 1. Mean days to radiation between surgical techniques.

Table 2. Time to Radiation

	Oncoplastic (n = 220)	Lumpectomy (n = 267)	*P*
Mean days to radiation	60.5 ± 30.0	56.2 ± 18.9	0.059
Median days	56	51	

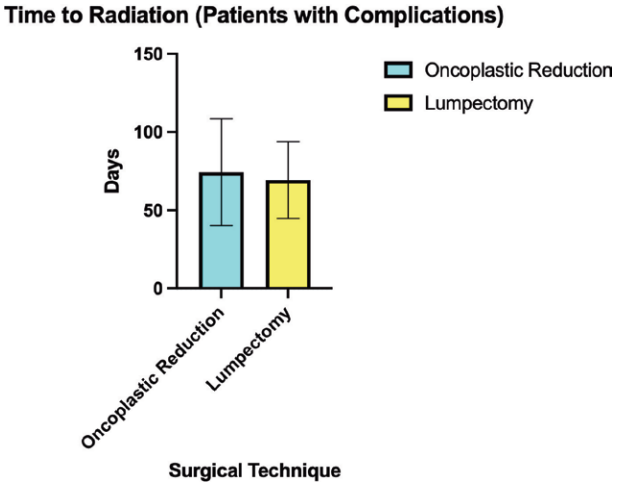

Fig. 2. Mean days to radiation among patients with complications.

DISCUSSION

An oncoplastic surgical approach to the management of breast cancer and partial mastectomy increases the aesthetic outcomes and widens the scope of breast conserving surgery to include patients with larger or more poorly located tumors.[12] Lumpectomy in combination with OCR allows for significantly larger resection volumes and significant reduction in the positive margin rate (10% oncoplastic in contrast to 20%–40% lumpectomy alone).[7,12] Prior studies contrasting OCR to traditional lumpectomy have validated the overall safety of OCR with similar survival and oncological outcomes and without limiting the ability to screen for postoperative recurrence.[9,11,12] However, OCR postoperative complications have previously demonstrated a delay to the initiation of radiation therapy.[7] Adjuvant radiation therapy is a key component after lumpectomy, as it has demonstrated a decrease in local recurrence by 50%–60%.[10]

Although the discussion on the benefits of OCR over lumpectomy is growing, there are still very few studies

Table 3. Time to Radiation among Patients with Complications

	Oncoplastic (n = 220)	Lumpectomy (n = 267)	*P*
Any complication	45 (20.4)	6 (2.2)	<0.001
Major complications	5 (2.3)	1 (0.4)	0.096
Minor complications	40 (18.2)	5 (1.9)	<0.001
Complication type			
Delayed wound healing	24 (10.9)	4 (1.5)	<0.001
Infection	9 (4.1)	1 (0.4)	0.007
Seroma	7 (3.2)	0 (0)	0.004
Hematoma	4 (1.8)	1 (0.4)	0.180
Nipple necrosis	1 (0.5)	0 (0)	0.452
	Oncoplastic (n = 45)	**BCS (n = 6)**	*P*
Mean days to radiation in patients who had a complication	74.3±34.3	69.3±24.5	0.732
Median days to radiation in patients who had a complication	67.0	64.5	

Table 4. Results of Multiple Variable Linear Regression with Respect to Days to Radiation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.241	0.058	0.04	18.60698

Predictors: (constant), complications, smoking, hypertension, pathology, chemotherapy, diabetes, age, BMI, technique

ANOVA

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	10146.251	9	1127.361	3.256	0.001
	Residual	164454.399	475	346.22		
	Total	174600.65	484			

Dependent variable: days to radiation

Predictors: (constant), complications, smoking, hypertension, pathology, chemotherapy, diabetes, age, BMI, technique

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	Std. Error	Beta		
1	(Constant)	39.738	7.2		5.519	<0.001
	Technique	−2.5	1.91	−0.066	−1.309	0.191
	Pathology	3.972	4.148	0.044	0.958	0.339
	Smoking	1.825	4.017	0.02	0.454	0.65
	Diabetes	4.345	2.945	0.068	1.475	0.141
	Hypertension	1.141	1.938	0.03	0.589	0.556
	Chemotherapy	1.155	2.922	0.018	0.396	0.693
	Age	0.045	0.082	0.027	0.554	0.58
	BMI	0.379	0.128	0.148	2.97	0.003
	Complications	5.089	2.987	0.079	1.703	0.089

Dependent variable: days to radiation.

examining the relationship between surgical complications, oncologic outcome, and timing to radiation treatment. This is the first article to compare and evaluate the relationship of complications in the context of the time to initiation of radiation therapy after partial mastectomy without oncoplastic approach in contrast to partial mastectomy with an oncoplastic approach.

In our analysis, we have shown that, in contrast to a previous study,[7] there was no significant effect in time to radiation. Although OCR resulted in a higher rate of complications, there was no difference in the time to initiation of radiation therapy between the oncoplastic and lumpectomy groups. Although the time to radiation was higher and trended toward significance in the oncoplastic reduction group, it was not statistically significant. Multiple variable linear regression analysis did not reveal presence of complications, surgical technique, or tumor pathology to be independently associated with increased time to radiation. Only BMI was found to be a significant independent predictor of increased days to radiation. It should also be noted that there was a significant difference in BMI between cohorts, with increased BMI among patients undergoing OCR (Table 4). (**See graph, Supplemental Digital Content 1,** which displays the multiple variable linear regression analysis results. **http://links.lww.com/PRSGO/C543**.) Future studies should further investigate the potential underlying link between elevated BMI and delay in time to radiation, which may be mediated by lower socioeconomic status or health literacy. Possible alternative causes of delays to radiation treatment are still an important consideration and may potentially be avoided through alterations in patient selection or surgical technique. There were higher rates of chemotherapy in the lumpectomy cohort (13.5%

compared with 5.9% in the oncoplastic cohort); however, only 14% of the patients who underwent chemotherapy in the lumpectomy cohort experienced a delay in radiation outside of 10 weeks.

Studies evaluating time to radiation after oncoplastic surgery have reported that no such universal timeline for initiation of postoperative radiation therapy exists, and it is often institutional, varying from 4 to 10 weeks.[7] Among patients with complications who underwent OCR, 47% experienced delays in radiation outside of 10 weeks. Compared with patients with complications who underwent lumpectomy, 50% experienced delays in radiation outside of 10 weeks. The difference in days to radiation among patients with complications who underwent OCR versus lumpectomy was not statistically significant. Although the complications were higher among individuals undergoing OCR, only five were deemed major complications.

De Lorenzi et al found similar findings to our study, reporting that in a series of 454 patients, there were no delays in adjuvant radiation therapy even if there was a complication of surgery.[10] Meretoja et al looked at 90 patients and found two who had delayed radiation treatment due to wound healing.[13] Neither elaborated on the specific time frame that was considered a delay. Hebert-Croteu et al found that in patients who exceeded the 12-week mark to start radiation therapy postoperatively, there was a 75% higher chance of a local recurrence.[14] However, although the longer waiting time to radiotherapy seemed to compromise local control, as long as radiation was received within the 16-week optimal radiation initiation interval proposed, delays within that time frame did not influence survival at 7 years.[14]

One of the limitations of this article is that there are numerous patient comorbidities outside the factors of hypertension, diabetes, age, tumor pathology, and BMI that have been shown to delay wound healing,[15,16] and these may have contributed to the delay to initiation of radiation treatment. However, upon performing multiple variable linear regression analysis for the factors included in this study, only BMI was shown to be a significant, independent predictor of increased time to radiation (**See graph, Supplemental Digital Content 1, http://links.lww.com/PRSGO/C543**). Furthermore, radiation modalities are increasing, and the use of intraoperative radiation therapy will likely affect this patient population; it remains to be seen the impact this could have on the rates of complications and removing the issue of timing to initiate radiation treatment.[17] Further discussion and evaluation of these modalities and techniques would be warranted to assess not just efficacy but also their evolving roles in breast surgery treatments.

Other limitations of our study stem from the lack of data regarding patient satisfaction and long-term oncologic recurrence. The primary goal of our study was not to evaluate patient satisfaction or long-term recurrence; however, previous studies have found improved patient-reported outcomes among patients undergoing OCR.[18,19] As for the issue of oncologic recurrence, a previous study from our institution found equivalent long-term recurrence rates between surgical techniques.[20]

The discussion of delay in radiation after reconstructive breast modalities also extends to procedures such as mastectomy with immediate breast reconstruction. One study by Shammas et al found that despite a modest delay in initiation of radiation therapy after immediate breast reconstruction, the delay did not impact overall survival.[21] Examining overall survival, and patient-reported outcomes are important factors that are downstream of the time to radiation. Given the numerous options for breast reconstruction and the impact on radiation, further studies may evaluate how these techniques differ regarding initiation of radiation, patient-reported outcomes, and overall survival. Overall, despite higher rates of complications, OCR includes many benefits such as more extensive tumorectomy and better aesthetic results alongside higher patient satisfaction and quality of life.[18]

CONCLUSIONS

The results of this study indicate that OCR is associated with an increased rate of complications when compared with lumpectomy, though not associated with an increased time to radiation, even among patients with complications. We offer the data presented here to open the topic for discussion on partial breast reconstruction by highlighting the minimal impact of OCR on delay in time to radiation and the potential benefits on patient-reported outcomes, despite higher complication rates. We feel that OCR is a safe and beneficial alternative for select patients who would have traditionally undergone lumpectomy.

DISCLOSURE

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

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