Published in final edited form as:

Breast J. 2018 July ; 24(4): 567–573. doi:10.1111/tbj.12977.

Does Response to Neoadjuvant Chemotherapy Impact Breast Reconstruction?

Michael R. Cassidy, MD^{*}, Emily C. Zabor, MS[†], Michelle Stempel, MPH^{*}, Babak Mehrara, MD^{*}, and Mary L. Gemignani, MD, MPH^{*}

^{*}Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, NY

[†]Department of Epidemiology and Biostatistics, Memorial Sloan Kettering Cancer Center, New York, NY

Abstract

Introduction—Neoadjuvant chemotherapy (NAC) is administered in breast cancer treatment for downstaging of disease. Here we determined the impact of response to NAC on breast reconstruction uptake.

Materials and Methods—A prospective NAC and mastectomy database with or without reconstruction was reviewed with IRB approval. Univariable analyses were conducted using Kruskal-Wallis or Fisher's exact tests. Multivariable logistic regression was used to adjust for potential confounders.

Results—We identified 271 patients with unilateral breast cancer receiving NAC and either unilateral or bilateral mastectomy from 9/2013-5/2016. 70 (25.8%) had a pCR to NAC. 175 (64.6%) had immediate reconstruction (IR), and 96 had no IR. On univariable analysis, younger age ($p<0.001$), smaller T-stage at presentation ($p<0.001$), bilateral versus unilateral mastectomy ($p<0.001$) and HR-negative tumor subtype ($p=0.006$) were significantly associated with higher IR rates. On multivariable analysis, pCR ($p=0.792$) and tumor subtype ($p=0.061$) were not significantly associated with IR; T-stage was significantly associated with IR ($p<0.001$), such that patients with T4 tumors at presentation had lower odds of IR (OR 0.10, 95% CI 0.02-0.50), even when accounting for response to NAC. 173 (63.8%) received adjuvant radiation therapy; this was associated with lower IR frequency ($p=0.048$) but was not associated with reconstruction type (tissue expander versus autologous, $p=1.0$) among 175 patients who had IR.

Corresponding author: Mary L. Gemignani, MD, Breast Service, Department of Surgery, Memorial Sloan Kettering Cancer Center, 300 East 66th Street, New York, NY 10065, (T) 646 888 5359, (F) 646 888 4921, gemignam@mskcc.org.

Disclosures: The preparation of this manuscript was funded in part by NIH/NCI Cancer Center Support Grant No. P30 CA008748 to Memorial Sloan Kettering Cancer Center, and this study was presented in part in poster format at the 18th Annual Meeting of the American Society of Breast Surgeons, April 26-30, 2017, Las Vegas, NV. The authors have no conflict of interest disclosures to report.

Authors' Contributions: The following authors have made substantial contributions to the intellectual content through conception, design of the study, and critical revision of the manuscript: Michael R. Cassidy, MD, Emily C. Zabor, MS, Michelle Stempel, MPH, Babak Mehrara, MD, Mary L. Gemignani, MD, MPH. The following individuals have made substantial contributions to the intellectual content through conception and design of the study, analysis and interpretation of data, drafting of the manuscript and critical revision of the manuscript for important intellectual content: Michael R. Cassidy, MD, Emily C. Zabor, MS, Michelle Stempel, MPH, Babak Mehrara, MD, Mary L. Gemignani, MD, MPH.

Disclosure: The authors have no potential conflict of interest to disclose.

Conclusion—In patients who have mastectomy after NAC, IR is influenced by age, T-stage at presentation, and choice of bilateral mastectomy, but not by response to NAC. A subset of patients who are young, with earlier T-stage and pCR, are more likely to proceed with bilateral mastectomy.

Keywords

breast cancer; neoadjuvant chemotherapy; breast reconstruction

Introduction

Neoadjuvant systemic therapy for breast cancer is administered prior to surgical management to achieve a number of clinical goals.^{1,2} For patients with large tumors at presentation, neoadjuvant chemotherapy (NAC) may allow for downstaging of the primary site, permitting consideration for breast-conservation surgery (BCS) if adequate response is achieved.³⁻⁵ The rates of BCS are higher in women who receive neoadjuvant therapy when compared to those who do not, adjusting for stage at presentation.⁶ Additionally, in an era of evolving regional node management, patients who present with axillary node metastases and subsequently convert to clinically node negative after NAC may be staged with sentinel lymph node biopsy. The morbidity of an axillary lymph node dissection can be avoided if a complete pathologic response is achieved in the axillary nodes.⁷⁻¹² The response to NAC is also an important prognostic indicator that allows for an assessment of tumor response during treatment.¹³

The response to NAC is largely influenced by the histologic subtype of breast cancer. Patients with hormone receptor negative, HER2 positive breast cancers have the highest rate of pathologic complete response (pCR), ranging from 33-45%, while patients with hormone receptor positive, HER2 negative tumors have the lowest rate of pCR (15-23%).^{14,15}

Patients receiving NAC may undergo mastectomy with or without reconstruction, either because of inadequate downstaging, as a planned procedure, or because of patient preference. NAC has been established as a valuable treatment strategy in the management of breast cancer. However, the extent to which response to NAC influences the choice for immediate reconstruction (IR) after mastectomy is not known. Here we sought to determine the impact of response to NAC on breast reconstruction.

Methods

We obtained Memorial Sloan Kettering Cancer Center (MSK) Institutional Review Board approval to perform a retrospective review of a prospective database of patients with breast cancer treated with NAC at MSK between September 2013 and May 2016. Our study population included only patients with unilateral breast cancer who underwent either unilateral or bilateral mastectomy with or without IR.

Clinicopathologic features and details of treatment course were collected. Clinical stage at presentation was derived from physical examination and imaging characteristics as recorded in the database. Details of surgery, treatment course, including NAC agents used, use of

postmastectomy radiation therapy, and type of reconstruction (if any) were derived from the medical record. Final pathologic characteristics and stage were extracted from pathology reports. PCR to NAC was characterized as absence of residual invasive or in situ breast cancer in both the breast and axillary lymph nodes. Patients were stratified into two groups: pCR and no pCR.

Patients received NAC regimens including an anthracycline, taxane, or both. HER2 positive patients received trastuzumab or trastuzumab plus pertuzumab. Clinically abnormal lymph nodes were evaluated at presentation with ultrasonography and fine needle aspiration, and classified as node negative or node positive. None of the patients had surgical axillary sampling or sentinel node biopsy before NAC. After NAC, axillary lymph nodes were reassessed clinically. Patients with persistent positive axillary nodes underwent axillary dissection, while those who converted to clinically node negative were offered sentinel node biopsy. If sentinel nodes were positive after NAC, axillary lymph node dissection was performed, and if nodes were negative, no further axillary surgery was performed. Indications for postmastectomy radiation therapy were clinical stage 3 disease at presentation or clinical stage 2 disease with residual disease after NAC.

To test for differences between groups, the Kruskal-Wallis test was used for continuous variables, and Fisher's exact test was used for categorical variables. For binary outcomes, multivariable logistic regression was used to examine associations while adjusting for potential confounders. Confounders were determined using a mix of clinical and statistical judgment. A p-value < 0.05 was considered statistically significant. All statistical analyses were conducted using R software version 3.2.5 (R Core Development Team, Vienna, Austria).

Results

We identified 271 patients with unilateral breast cancer receiving NAC and mastectomy between September 2013 and May 2016. Median age was 49 years (range 27-87). At presentation, 203 patients (74.9%) were not candidates for BCS, 38 patients (14.0%) were borderline candidates for BCS, and 30 patients (11.1%) were candidates for BCS. After completion of NAC, 168 patients (62%) were not candidates for BCS while 101 patients (37.3%) were candidates for BCS. Contraindications to BCS included tumor to breast size ratio, multicentric disease, inflammatory breast cancer, and progression during treatment. Of the 101 patients who were candidates for BCS after NAC, the most common reason for choosing mastectomy was patient preference (64 patients), followed by high genetic or familial risk (25 patients) and positive or close margin after attempt at BCS (9 patients). The reason was not known for 3 patients.

145 patients (53.5%) had unilateral mastectomy and 126 (46.5%) had bilateral mastectomy (Table 1). Patients who underwent bilateral mastectomy were more likely to have been candidates for BCS after NAC than were patients who had unilateral mastectomy (57.9% versus 19.3%, $p < .001$). In multivariable analysis, patients who were younger, those with lower T-stage, those with triple negative subtype, and those with a pCR were more likely to undergo bilateral mastectomy (Table 2). Patients who chose bilateral mastectomy were more

likely to have a pCR when compared with those who underwent unilateral mastectomy (32.5% versus 20.0%, $p = 0.026$).

Overall, 175 patients (64.6%) had IR and 96 (35.4%) had no IR (Table 3). On univariable analysis, younger age ($p < .001$), lower T-stage at presentation ($p < .001$), bilateral mastectomy ($p < .001$), and HR negative tumor subtype ($p = 0.006$) were significantly associated with higher rates of IR (Table 3). Neither residual palpable breast mass after NAC nor residual palpable lymphadenopathy were associated with frequency of IR ($p = 0.790$ and $p = 0.698$, respectively). In patients who had positive nodes after NAC, those with abnormal axillary lymph nodes by imaging prior to surgery had a lower rate of IR (52.2% compared with 71.2% for those without abnormal axillary nodes on imaging prior to surgery, $p = 0.020$). In contrast, a persistent breast abnormality on imaging after NAC was not significantly associated with IR ($p = 0.372$).

Of the entire cohort, 70 patients (25.8%) had a pCR while 201 patients (74.2%) did not. The pCR group had lower T-stage at presentation ($p = 0.006$) and was more frequently HR negative subtype ($p < 0.001$), but did not differ according to N-stage at presentation ($p = 0.177$). Of 194 patients who presented with clinically positive axillary lymph nodes, 138 converted to clinically node negative after NAC (71.1%). This included 77 of 115 patients (67.0%) who underwent IR and 61 of 79 (77.2%) patients who did not. Sentinel node biopsy followed by completion axillary node dissection were similar in both the no-reconstruction groups; 21 (21.9%) of patients compared to 51 (29.1%) of patients in the IR group. However, patients in the no-reconstruction group were more likely to not have a sentinel node biopsy and proceed with axillary node dissection at time of mastectomy as compared to those in the IR group (51.0% versus 17.7%, $p < .001$), thus likely representing a group of patients with greater burden of disease.

On multivariable analysis assessing association of response to NAC with IR, pCR ($p = 0.792$) and tumor subtype ($p = 0.061$) were not significantly associated with IR; T-stage at presentation was significantly associated with IR ($p < 0.001$) such that patients with T4 tumors had lower odds of IR (OR 0.10, 95% confidence interval [CI]: 0.02-0.50) even when accounting for response to NAC (Table 4).

173 patients (63.8%) received adjuvant radiation therapy; those who received adjuvant radiation therapy were less likely to undergo IR than those who did not (60.1% versus 72.4%, $p = 0.048$). Reconstruction type (tissue expander versus autologous) was not associated with adjuvant radiation therapy ($p = 1.0$). The median time from the date of surgery to the date of first adjuvant radiation treatment was 55 days in the entire cohort (interquartile range [IQR] 44-68 days). In the 104 patients who underwent IR, the median time to radiation was 60 days (IQR 50-71 days) whereas in those who did not have IR, the median time to radiation was 47 days (IQR 40-59 days) ($p < .001$). In patients with prolonged time to initiation of radiation therapy, radiation was delayed due to receipt of additional chemotherapy.

Of the 175 patients who had IR, 8 (4.6%) were complicated by infection requiring removal of the tissue expander. Five patients (2.9%) had flap necrosis, while 4 patients (2.3%) developed a postoperative hematoma that required re-operation.

Discussion

We found that response to NAC, as assessed by both clinical response and pCR, was not correlated with uptake of IR. Rather, the factors associated with reconstruction after NAC are younger age, early T stage at presentation, and choice of bilateral mastectomy, even when controlling for response to NAC. These results demonstrate that the majority of women who receive NAC are candidates for breast reconstruction after mastectomy.

The overall rate of pCR in our study was 25.8%. However, as observed in other studies, the rate of nodal response was higher. We noted significant axillary downstaging; 71.1% of patients who presented with axillary metastases converted to clinically node negative by the time of surgery. Considering final nodal pathology, the rate of conversion from node positive at presentation to pathologically node negative was 43.3%. Neither conversion from clinically node positive to clinically node negative nor pCR was associated with increased rates of IR.

Although overall response to NAC was not associated with IR, it was statistically associated with choice of bilateral mastectomy. Patients with pCR were more likely to undergo bilateral mastectomy than those without pCR. It is likely that contralateral prophylactic mastectomy would have been discouraged in patients who still had significant disease after NAC.

Overall, the majority of patients who underwent mastectomy rather than BCS were not candidates for BCS based on tumor factors. The decision for contralateral prophylactic mastectomy in patients who underwent bilateral mastectomy was largely by patient choice.

The safety of IR after NAC has been well established in recent reports. In a retrospective study, Donker et al compared the short-term surgical outcomes of 37 patients undergoing immediate breast reconstruction after NAC to 176 of those who did not receive NAC. The rate of short-term surgical complications, such as hematoma, seroma, wound infection, and implant loss, was not significantly different between the groups.¹⁶ The rates of short-term complications in our patients were similar to those reported in this study. Other reports have similarly shown acceptable complication rates of immediate breast reconstruction after NAC, even when radiation therapy is also utilized.¹⁷⁻²¹ In terms of oncologic outcomes, Prabhu et al showed that IR may delay time to postmastectomy radiation in patients treated with neoadjuvant chemotherapy, but that there were no differences in locoregional control, disease-specific survival, and overall survival when compared to a cohort of patients who did not have breast reconstruction.²⁰ Similarly, the study by Gouy et al also demonstrated equivalent oncologic outcomes in patients treated with IR when compared to those who underwent mastectomy alone after NAC.²² In that study, IR did not delay the start of adjuvant radiation therapy. In our study, patients who underwent IR received the first dose of radiation at a median of 60 days after surgery, while those who did not have IR received the first dose of radiation at a median of 47 days.

The absolute rate of IR in our population was slightly lower in patients who received adjuvant breast irradiation than in those who did not (60.1% versus 72.4%). This is consistent with a study of locoregional management after NAC in the American College of Surgeons Oncology Group (ACOSOG) Z1071 trial that demonstrated that patients who had reconstruction were statistically less likely to receive adjuvant radiation therapy. Differences between that analysis and our study included a larger number of patients (685) and, more importantly, all patients in that study had clinically node-positive disease. Therefore, the overall rate of adjuvant radiation was higher than in our study.

Our study is limited by its retrospective nature, and the inability to fully capture the many factors that contribute to individual patient and surgeon decision making. Because our study was limited to only patients who were having a mastectomy after NAC, the impact of response to NAC on surgical treatment is limited. Further, it represents data collected at a designated cancer center with a high-volume breast surgery oncology practice.

We noted a significant benefit to using NAC in our study, including axillary downstaging. Our study suggests that age and primary T-stage at presentation are predictors of IR in patients who are having a mastectomy after NAC. The response to NAC was not associated with a decision to undergo IR. In the patients who had IR, the complications were low and IR did not significantly delay radiation therapy administration. Additionally, age, T-stage at presentation, and pCR to NAC did influence the decision to proceed with bilateral mastectomy. Once the decision to proceed with a unilateral mastectomy was made, patients with a pCR were more likely to have a bilateral mastectomy and undergo IR.

In conclusion, for patients who need or choose a mastectomy after NAC, IR can be safely recommended. The response to NAC did not appear to be a factor in decision to proceed with IR.

Acknowledgments

The preparation of this manuscript was funded in part by NIH/NCI Cancer Center Support Grant No. P30 CA008748 to Memorial Sloan Kettering Cancer Center, and this study was presented in part in poster format at the 18th Annual Meeting of the American Society of Breast Surgeons, April 26-30, 2017, Las Vegas, NV. The authors have no conflict of interest disclosures to report.

References

1. Gralow JR, Burstein HJ, Wood W, et al. Preoperative therapy in invasive breast cancer: pathologic assessment and systemic therapy issues in operable disease. *J Clin Oncol*. 2008; 26(5):814–9. [PubMed: 18258991]
2. Teshome M, Hunt KK. Neoadjuvant therapy in the treatment of breast cancer. *Surg Oncol Clin N Am*. 2014; 23(3):505–23. [PubMed: 24882348]
3. Gianni L, Baselga J, Eiermann W, et al. Phase III trial evaluating the addition of paclitaxel to doxorubicin followed by cyclophosphamide, methotrexate, and fluorouracil, as adjuvant or primary systemic therapy: European Cooperative Trial in Operable Breast Cancer. *J Clin Oncol*. 2009; 27(15):2474–81. [PubMed: 19332727]
4. Rastogi P, Anderson SJ, Bear HD, et al. Preoperative chemotherapy: updates of National Surgical Adjuvant Breast and Bowel Project Protocols B-18 and B-27. *J Clin Oncol*. 2008; 26(5):778–85. [PubMed: 18258986]

5. Wolmark N, Wang J, Mamounas E, et al. Preoperative chemotherapy in patients with operable breast cancer: nine-year results from National Surgical Adjuvant Breast and Bowel Project B-18. *J Natl Cancer Inst Monogr.* 2001; (30):96–102. [PubMed: 11773300]
6. Killelea BK, Yang VQ, Mougalian S, et al. Neoadjuvant chemotherapy for breast cancer increases the rate of breast conservation: results from the National Cancer Database. *J Am Coll Surg.* 2015; 220(6):1063–9. [PubMed: 25868410]
7. Boileau JF, Poirier B, Basik M, et al. Sentinel node biopsy after neoadjuvant chemotherapy in biopsy-proven node-positive breast cancer: the SN FNAC study. *J Clin Oncol.* 2015; 33(3):258–64. [PubMed: 25452445]
8. Boughey JC, Suman VJ, Mittendorf EA, et al. Sentinel lymph node surgery after neoadjuvant chemotherapy in patients with node-positive breast cancer: the ACOSOG Z1071 (Alliance) clinical trial. *Jama.* 2013; 310(14):1455–61. [PubMed: 24101169]
9. Fu JF, Chen HL, Yang J, et al. Feasibility and accuracy of sentinel lymph node biopsy in clinically node-positive breast cancer after neoadjuvant chemotherapy: a meta-analysis. *PLoS One.* 2014; 9(9):e105316. [PubMed: 25210779]
10. Kuehn T, Bauerfeind I, Fehm T, et al. Sentinel-lymph-node biopsy in patients with breast cancer before and after neoadjuvant chemotherapy (SENTINA): a prospective, multicentre cohort study. *Lancet Oncol.* 2013; 14(7):609–18. [PubMed: 23683750]
11. Mamounas EP, Brown A, Anderson S, et al. Sentinel node biopsy after neoadjuvant chemotherapy in breast cancer: results from National Surgical Adjuvant Breast and Bowel Project Protocol B-27. *J Clin Oncol.* 2005; 23(12):2694–702. [PubMed: 15837984]
12. Newman EA, Sabel MS, Nees AV, et al. Sentinel lymph node biopsy performed after neoadjuvant chemotherapy is accurate in patients with documented node-positive breast cancer at presentation. *Ann Surg Oncol.* 2007; 14(10):2946–52. [PubMed: 17514407]
13. Colleoni M, Viale G, Goldhirsch A. Lessons on responsiveness to adjuvant systemic therapies learned from the neoadjuvant setting. *Breast.* 2009; 18(3):S137–40. [PubMed: 19914533]
14. Gianni L, Pienkowski T, Im YH, et al. Efficacy and safety of neoadjuvant pertuzumab and trastuzumab in women with locally advanced, inflammatory, or early HER2-positive breast cancer (NeoSphere): a randomised multicentre, open-label, phase 2 trial. *Lancet Oncol.* 2012; 13(1):25–32. [PubMed: 22153890]
15. Houssami N, Macaskill P, von Minckwitz G, et al. Meta-analysis of the association of breast cancer subtype and pathologic complete response to neoadjuvant chemotherapy. *Eur J Cancer.* 2012; 48(18):3342–54. [PubMed: 22766518]
16. Donker M, Hage JJ, Woerdeman LA, et al. Surgical complications of skin sparing mastectomy and immediate prosthetic reconstruction after neoadjuvant chemotherapy for invasive breast cancer. *Eur J Surg Oncol.* 2012; 38(1):25–30. [PubMed: 21963981]
17. Bowen ME, Mone MC, Buys SS, et al. Surgical Outcomes for Mastectomy Patients Receiving Neoadjuvant Chemotherapy: A Propensity-Matched Analysis. *Ann Surg.* 2017; 265(3):448–56. [PubMed: 27280515]
18. Monrigal E, Dauplat J, Gimbergues P, et al. Mastectomy with immediate breast reconstruction after neoadjuvant chemotherapy and radiation therapy. A new option for patients with operable invasive breast cancer. Results of a 20 years single institution study *Eur J Surg Oncol.* 2011; 37(10):864–70. [PubMed: 21843920]
19. Paillocher N, Florczak AS, Richard M, et al. Evaluation of mastectomy with immediate autologous latissimus dorsi breast reconstruction following neoadjuvant chemotherapy and radiation therapy: A single institution study of 111 cases of invasive breast carcinoma. *Eur J Surg Oncol.* 2016; 42(7):949–55. [PubMed: 27134148]
20. Prabhu R, Godette K, Carlson G, et al. The impact of skin-sparing mastectomy with immediate reconstruction in patients with Stage III breast cancer treated with neoadjuvant chemotherapy and postmastectomy radiation. *Int J Radiat Oncol Biol Phys.* 2012; 82(4):e587–93. [PubMed: 22197232]
21. Zinzindohoue C, Bertrand P, Michel A, et al. A Prospective Study on Skin-Sparing Mastectomy for Immediate Breast Reconstruction with Latissimus Dorsi Flap After Neoadjuvant Chemotherapy

- and Radiotherapy in Invasive Breast Carcinoma. *Ann Surg Oncol*. 2016; 23(7):2350–6. [PubMed: 26957504]
22. Gouy S, Rouzier R, Missana MC, et al. Immediate reconstruction after neoadjuvant chemotherapy: effect on adjuvant treatment starting and survival. *Ann Surg Oncol*. 2005; 12(2):161–6. [PubMed: 15827797]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 1
Patient and disease characteristics by mastectomy group

Factor	Overall (n = 271)	Bilateral (n = 126)	Unilateral (n = 145)	p-value
Age, median (range)	49 (27, 87)	45 (27, 69)	53 (32, 87)	< .001
Tumor size, median (range)	4.3 (0.7, 15)	4 (0.7, 14)	5 (1.2, 15)	< .001
T stage at presentation, n (%)				< .001
T1	21 (7.7)	19 (15.1)	2 (1.4)	
T2	129 (47.6)	70 (55.6)	59 (40.7)	
T3	73 (26.9)	31 (24.6)	42 (29)	
T4	48 (17.7)	6 (4.8)	42 (29)	
N stage at presentation, n (%)				0.001
N0	77 (28.4)	45 (35.7)	32 (22.1)	
N1	162 (59.8)	73 (57.9)	89 (61.4)	
N2	16 (5.9)	7 (5.6)	9 (6.2)	
N3	16 (5.9)	1 (0.8)	15 (10.3)	
Breast cancer subtype, n (%)				0.009
ER-, PR-, HER2-	73 (26.9)	46 (36.5)	27 (18.6)	
ER-, PR-, HER2+	31 (11.4)	11 (8.7)	20 (13.8)	
ER/PR+, HER2-	112 (41.3)	45 (35.7)	67 (46.2)	
ER/PR+, HER2+	53 (19.6)	23 (18.3)	30 (20.7)	
NA	2 (0.7)	1 (0.8)	1 (0.7)	
Adjuvant XRT				0.205
No	98 (36.2)	51 (40.5)	47 (32.4)	
Yes	173(63.8)	75 (59.5)	98 (67.6)	
Candidate for BCS before NAC				0.005
Yes	30 (11.1)	20 (15.9)	10 (6.9)	
Borderline	38 (14.0)	23 (18.3)	15 (10.3)	
No	203 (74.9)	83 (65.9)	120 (82.8)	
Candidate for BCS after NAC				< .001
Yes	101(37.3)	73 (57.9)	28 (19.3)	
Borderline	2 (0.7)	0 (0)	2 (1.4)	
No	168 (62.0)	53 (42.1)	115 (79.3)	
Pathologic complete response				0.026
Yes	70 (25.8)	41 (32.5)	29 (20.0)	
No	201 (74.2)	85 (67.5)	116 (80)	

ER, estrogen receptor; PR, progesterone receptor; NA, not available; XRT, radiation therapy; BCS, breast-conserving surgery; NAC, neoadjuvant chemotherapy

Table 2
Multivariable analysis of the association between response to NAC and bilateral mastectomy

	OR (95% CI)	p-value
Pathologic complete response	2.37 (1.11-5.08)	0.026
Age	0.94 (0.91-0.96)	< .001
T-stage		< .001
T1	1.00	
T2	0.17 (0.04-0.8)	
T3	0.11 (0.02-0.52)	
T4	0.03 (0-0.15)	
Tumor subtype		0.049
Triple negative	1.00	
ER-, PR-, HER2+	0.33 (0.12-0.92)	
ER/PR+, HER2-	0.6 (0.3-1.23)	
ER/PR+, HER2+	0.34 (0.15-0.81)	

OR, odds ratio; CI, confidence interval; ER, estrogen receptor; PR, progesterone receptor

Table 3
Patient and disease characteristics by reconstruction

Factor	Overall (n = 271)	None/delayed recon (n = 96)	Immediate recon (n = 175)	p-value
Age, median (range)	49 (27, 87)	56.5 (32, 87)	45 (27, 74)	< .001
Tumor size, median (range)	4.3 (0.7, 15)	5 (1.2, 15)	4 (0.7, 14)	0.001
T stage at presentation, n (%)				< .001
T1	21 (7.7)	4 (4.2)	17 (9.7)	
T2	129 (47.6)	30 (31.2)	99 (56.6)	
T3	73 (26.9)	21 (21.9)	52 (29.7)	
T4	48 (17.7)	41 (42.7)	7 (4)	
N stage at presentation, n (%)				< .001
N0	77 (28.4)	17 (17.7)	60 (34.3)	
N1	162 (59.8)	59 (61.5)	103 (58.9)	
N2	16 (5.9)	8 (8.3)	8 (4.6)	
N3	16 (5.9)	12 (12.5)	4 (2.3)	
Breast cancer subtype, n (%)				0.006
ER-, PR-, HER2-	73 (26.9)	19 (19.8)	54 (30.9)	
ER-, PR-, HER2+	31 (11.4)	10 (10.4)	21 (12)	
ER/PR+, HER2-	112 (41.3)	53 (55.2)	59 (33.7)	
ER/PR+, HER2+	53 (19.6)	13 (13.5)	40 (22.9)	
NA	2 (0.7)	1 (1)	1 (0.6)	
Residual palpable breast mass after NAC				0.790
No	178 (65.7)	62 (34.8)	116 (65.2)	
Yes	93 (34.3)	34 (36.6)	59 (33.4)	
Clinical axillary node status after NAC				0.698
Negative	238 (87.8)	83 (86.5)	155 (88.6)	
Positive	33 (12.2)	13 (13.5)	20 (11.4)	
Persistent breast abnormality on imaging after NAC				0.372
No	42 (15.5)	12 (28.6)	30 (71.4)	
Yes	146 (53.9)	50 (34.2)	96 (65.8)	
Not done	83 (30.6)	34 (41)	49 (59)	
Persistent abnormal nodes on imaging after NAC				0.020
No	139 (51.3)	40 (28.8)	99 (71.2)	
Yes	46 (17.0)	22 (47.8)	24 (52.2)	
Not done	86 (31.7)	34 (39.5)	52 (60.5)	
Breast surgery, n (%)				< .001
Unilateral mastectomy	145 (53.5)	75 (78.1)	70 (40.0)	
Bilateral mastectomy	126 (46.5)	21 (21.9)	105 (60.0)	
Nodal surgery, n (%)				< .001

Factor	Overall (n = 271)	None/delayed recon (n = 96)	Immediate recon (n = 175)	p-value
SLNB only	117 (43.2)	24 (25.0)	93 (53.1)	
SLNB and ALND	72 (26.6)	21 (21.9)	51 (29.1)	
ALND only	80 (29.5)	49 (51.0)	31 (17.7)	
None	2 (0.7)	2 (2.1)	0 (0)	
Number of positive axillary nodes, median (IQR)	1 (0-6)	2 (0-5)	1 (0-6)	0.571
Pathologic complete response				0.470
Yes	70 (25.8)	22 (22.9)	48 (27.4)	
No	201 (74.2)	74 (77.1)	127 (72.6)	
Adjuvant XRT				0.050
No	98 (36.2)	27 (27.6)	71 (40.0)	
Yes	173 (63.8)	69 (72.4)	104 (59.9)	

Recon, reconstruction; ER, estrogen receptor; PR, progesterone receptor; NA, not available; NAC, neoadjuvant chemotherapy; SLNB, sentinel lymph node dissection; ALND, axillary lymph node dissection; XRT, radiation therapy

Table 4
Multivariable analysis of the association between response to neoadjuvant chemotherapy and immediate reconstruction

	OR (95% CI)	p-value
Pathologic complete response	0.88 (0.35-2.24)	0.792
Bilateral vs unilateral mastectomy	2.63 (1.26-5.48)	0.010
Age	0.92 (0.89-0.95)	< 0.001
T-stage		< 0.001
T1	1.00	
T2	1.31 (0.31-5.43)	
T3	0.98 (0.22-4.27)	
T4	0.1 (0.02-0.5)	
Tumor subtype		0.061
Triple negative	1.00	
ER-, PR-, HER2+	1.98 (0.51-7.63)	
ER/PR+, HER2-	0.54 (0.24-1.22)	
ER/PR+, HER2+	1.64 (0.58-4.63)	

OR, odds ratio; CI, confidence interval; ER, estrogen receptor; PR, progesterone receptor