


Effects of COVID-19 on mastectomy and breast reconstruction rates: A national surgical sample

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Abstract

Background: The COVID-19 pandemic profoundly impacted breast cancer treatment in 2020. Guidelines initially halted elective procedures, subsequently encouraging less invasive surgeries and restricting breast reconstruction options. We examined the effects of COVID-19 on oncologic breast surgery and reconstruction rates during the first year of the pandemic.

Methods: Using the National Surgical Quality Improvement Program, we performed an observational examination of female surgical breast cancer patients from 2017 to 2020. We analyzed annual rates of lumpectomy, mastectomy (unilateral/contralateral prophylactic/bilateral prophylactic), and breast reconstruction (alloplastic/autologous) and compared 2019 and 2020 reconstruction cohorts to evaluate the effect of COVID-19.

Results: From 2017 to 2020, 175 949 patients underwent lumpectomy or mastectomy with or without reconstruction. From 2019 to 2020, patient volume declined by 10.7%, unilateral mastectomy rates increased (70.5% to 71.9%, $p = 0.003$), and contralateral prophylactic mastectomy rates decreased. While overall reconstruction rates were unchanged, tissue expander reconstruction increased (64.0% to 68.4%, $p < 0.001$) and direct-to-implant and autologous reconstruction decreased. Outpatient alloplastic reconstruction increased (65.7% to 73.8%, $p < 0.0001$), and length of hospital stay decreased for all reconstruction patients ($p < 0.0001$).

Conclusions: In 2020, there was a nearly 11% decline in breast cancer surgeries, comparable mastectomy and reconstruction rates, increased use of outpatient alloplastic reconstruction, and significantly reduced in-hospital time across all reconstruction types.

KEYWORDS

autologous, direct-to-implant, tissue expander

Abbreviations: ACS, American College of Surgeons; ASA, American Society of Anesthesiologists; BCT, breast-conserving therapy; BPM, bilateral prophylactic mastectomy; CPM, contralateral prophylactic mastectomy; DTI, direct-to-implant; NSQIP, National Surgical Quality Improvement Program; PROs, patient-reported outcomes; TE, tissue expander; UM, unilateral mastectomy.

Robyn N. Rubenstein and Carrie S. Stern contributed equally to this study.

1 | INTRODUCTION

The rise of the COVID-19 pandemic in 2020 caused unprecedented disruption in the delivery of surgical care for women with breast cancer, who constitute 14.8% of all new cancer cases in the United States.¹ Two days after the World Health Organization declared COVID-19 a global pandemic,² the American College of Surgeons (ACS) issued their first of several clinical guidelines regarding COVID-19 on March 13, 2020,^{3,4} recommending postponement of elective surgeries whenever feasible to protect patients and healthcare workers and conserve hospital resources. The ACS and the COVID-19 Pandemic Breast Cancer Consortium divided surgical breast cancer guidelines into three phases based on pandemic stage, COVID-19 institutional burden, and the likelihood of patient survival (see Table S1).⁴ Breast surgeons were encouraged to use breast-conserving therapy (BCT) whenever appropriate, pending the availability of radiation services. Early on, definitive mastectomy with or without reconstruction was recommended to be deferred, if possible.⁴ Surgeons were instructed to delay operative management whenever clinically appropriate.⁵ Neoadjuvant hormonal therapy and/or chemotherapy were considered safe methods of delaying surgery for eligible breast cancer patients.

As COVID-19 rates surged, breast cancer treatment guidelines were refined frequently, based on geographic and institutional COVID-19 burden.⁵⁻⁷ While hospital resources and staff were limited in the acute stage of the pandemic, a Special Communication on the treatment of breast cancer recommended that eligible patients continue undergoing BCT rather than mastectomy and that patients requiring mastectomy could undergo reconstruction if resources allowed.⁸ Notably, the COVID-19 Pandemic Breast Cancer Consortium guidelines limited breast reconstruction to alloplastic only, deferring autologous reconstruction.⁸ The pandemic remained at different phases across the United States, and as each region slowly recovered from the first wave, a priority classification system was introduced for triaging breast cancer surgery based on the acuity of the patient's condition, survival likelihood, and availability of institution-specific resources (see Tables S2 and S3).⁹ The guidelines continued to encourage less invasive procedures, outpatient recovery, contralateral prophylactic mastectomy (CPM) only for patients at high risk of contralateral breast cancer, and alloplastic reconstruction rather than autologous to reduce complication risks, inpatient stays, and patient exposure to COVID-19.¹⁰ While the ACS discouraged completion of delayed reconstruction in patients who previously underwent mastectomy pre-pandemic, they did not formally make recommendations regarding the appropriateness of delaying reconstruction for patients undergoing mastectomy during the pandemic.⁸ They reinforced the recommendation that physicians treat patients safely but promptly to prevent "backlogging" and extreme delays in the surgical care of breast cancer patients.¹¹ The ACS guidelines eventually permitted autologous reconstruction, depending on the

phase of the pandemic, geographic location, and available resources at the treating institution.¹²

Little is known of the effect these changes to breast cancer treatment guidelines had on lumpectomy, mastectomy (unilateral, contralateral prophylactic, bilateral prophylactic), and breast reconstruction (alloplastic and autologous) rates. The aim of this study was to examine how rates of oncologic breast surgery and breast reconstruction changed in 2020 due to the COVID-19 pandemic. A secondary aim was to compare basic patient demographics, surgical details, and hospitalization between the 2019 and 2020 alloplastic and autologous breast reconstruction cohorts to more closely evaluate the effects of COVID-19. We hypothesized that from 2019 to 2020 (1) the proportion of lumpectomy versus mastectomy procedures increased, as lumpectomy is an outpatient procedure, and (2) the proportion of alloplastic versus autologous reconstruction increased, as alloplastic reconstruction uses fewer hospital resources.

2 | METHODS

We used data abstracted from the ACS' National Surgical Quality Improvement Program (NSQIP) to perform an observational longitudinal analysis of female patients (≥ 18 years of age) who underwent lumpectomy or mastectomy from 2017 to 2020. NSQIP is an outcomes-based database that reports 30-day morbidity and mortality outcomes for all major inpatient and outpatient surgical procedures.¹³ We used CPT codes for lumpectomy and mastectomy with and without reconstruction to filter the NSQIP data and ICD-10 diagnosis codes Z15.01, Z40.01, and Z80.3 to distinguish between contralateral and bilateral prophylactic mastectomies. We assessed annual rates of lumpectomy versus mastectomy from 2017 to 2020; among patients who underwent a mastectomy we examined rates of unilateral mastectomy (UM), CPM, and bilateral prophylactic mastectomy (BPM), as well as rates of immediate alloplastic (which included direct-to-implant (DTI) and immediate tissue expander (TE) placement) and autologous reconstruction. Rates were reported as percentages, and trends were reported over time from 2017 to 2020.

To more closely evaluate the effects of COVID-19 on the breast reconstruction cohorts, we compared basic patient variables between the 2019 and 2020 alloplastic and autologous reconstruction cohorts. Variables of interest included age, race, ethnicity, American Society of Anesthesiologists (ASA) classification, inpatient/outpatient status, operative times, and total length of hospital stay in days. Categorical variables were evaluated using Fisher's exact test while continuous variables were compared using Student's *t* test. Inpatient and outpatient procedures were classified based on the "Inpatient/Outpatient" variable within the NSQIP data set. A *p*-value of <0.05 was considered significant. Statistical analyses were performed using R statistical software (version 4.0.3, packages: tidyverse).

3 | RESULTS

The study included 175 949 patients who underwent lumpectomy or mastectomy from 2017 to 2020 with or without breast reconstruction, with patient volume declining by 10.7% from 2019 to 2020 (2019: 45 882 patients; 2020: 40 957 patients) (Figure 1). From 2017 to 2020, lumpectomy rates decreased from 63.8% to 61.6%, while mastectomy rates increased from 36.2% to 38.4% (see Figure S1). There was a subtle variability in the annual rates per mastectomy type (Table 1 and Figure 2), with UM remaining the most common mastectomy type throughout the study period and BPM remaining the least common. UM rates increased from 2017 to 2018 (70.8% to 72.3% of all mastectomies), decreased from 2018 to 2019 (72.3% to 70.5%), and increased again from 2019 to 2020 (70.5% to 71.9%); concurrently, CPM rates decreased from 2017 to 2018 (26.4% to 24.7% of all mastectomies), increased from 2018 to 2019 (24.7% to 26.7%), and decreased from 2019 to 2020 (26.7% to 25.7%). BPM rates remained between 2% and 3% of all mastectomies throughout the study period.

Overall immediate alloplastic (DTI and TE) and autologous breast reconstruction rates decreased from 2017 to 2019 (48.6% to 46.6%) but remained stable from 2019 to 2020 (Table 1 and Figure 2). Alloplastic reconstruction rates were higher than autologous reconstruction throughout the study period (Table 1 and Figure 2). Alloplastic reconstruction rates decreased from 2017 to 2019 (87.2% to 84.8%) while autologous reconstruction increased (12.8% to 15.2%); however, there was a reversal in these trends from 2019 to 2020, with an increase in alloplastic reconstruction (84.8% to 86.6%) and decrease in autologous reconstruction (15.2% to 13.4%). When distinguishing types of alloplastic reconstruction, Table 1 and Figure 2 demonstrate a decrease in TE reconstruction from 2017 to 2019 (71.8% to 64.0%) with an increase in DTI reconstruction (15.4% to 20.7%). There was a reversal in these trends from 2019 to 2020, with an increase in TE reconstruction (64.0% to 68.4%) and a decrease in DTI (20.7% to 18.2%).

When comparing 2019 with 2020, there was an increase in UM rates (70.5% to 71.9%) and a slight decrease in CPM (26.7% to 25.7%) and BPM (2.8% to 2.4%) ($p = 0.003$) rates (Table 2). There was no difference in overall immediate breast reconstruction rates between 2019 and 2020 (46.6% to 46.7%, $p = 0.859$) (Table 2), but in 2020 there was a significant increase in alloplastic reconstruction (84.8% to 86.6%) and a decrease in autologous reconstruction (15.2% to 13.4%) ($p = 0.001$). Stratifying by method of alloplastic reconstruction, Table 2 and Figure 3 show an increase in TE reconstruction (64.0% to 68.4%) and a decrease in DTI reconstruction (20.7% to 18.2%) ($p < 0.001$).

When we compared the distribution of reconstruction procedures by mastectomy type in 2019 versus 2020 (Table 3), there was a significant increase in the use of alloplastic reconstruction in patients with UM (83.2% to 86.2%, $p < 0.0001$), no difference in patients with CPM (87.6% to 87.9%, $p = 0.714$), and minimal difference in patients with BPM (82.1% to 81.4%, $p = 0.847$). When distinguishing between types of alloplastic reconstruction (Figure 4), there was a significant increase in TE reconstruction (61.4% to 67.6%) and a decrease in DTI (21.8% to 18.6%) in patients with UM ($p < 0.0001$). In the CPM cohort, TE reconstruction increased and DTI and autologous reconstruction decreased, but these were not statistically significant ($p = 0.189$). In the BPM cohort, TE reconstruction decreased and DTI and autologous reconstruction increased, but these changes were not statistically significant either ($p = 0.839$).

When we compared 2019 versus 2020 basic demographic and clinical variables for alloplastic reconstruction patients (see Table S4), we noted minimal differences in age distribution and small differences in race and ethnicity, with a higher proportion of Black/African American ($p < 0.0001$) and Hispanic ($p = 0.001$) patients in 2020. There were fewer patients with ASA class 1 or 2 and more patients with ASA class 3 in 2020 ($p < 0.0001$). The mean operative time for alloplastic reconstruction procedures increased from 207.3 min to 212.9 min (median operative time: 2019, 196 min; 2020, 202 min; $p = 0.0001$). Outpatient alloplastic breast reconstruction increased from 65.6% in 2019 to 73.8% in 2020 ($p < 0.0001$). The proportion of

FIGURE 1 Surgical breast patients per year who underwent lumpectomy or mastectomy for benign or malignant purposes (2017–2020).

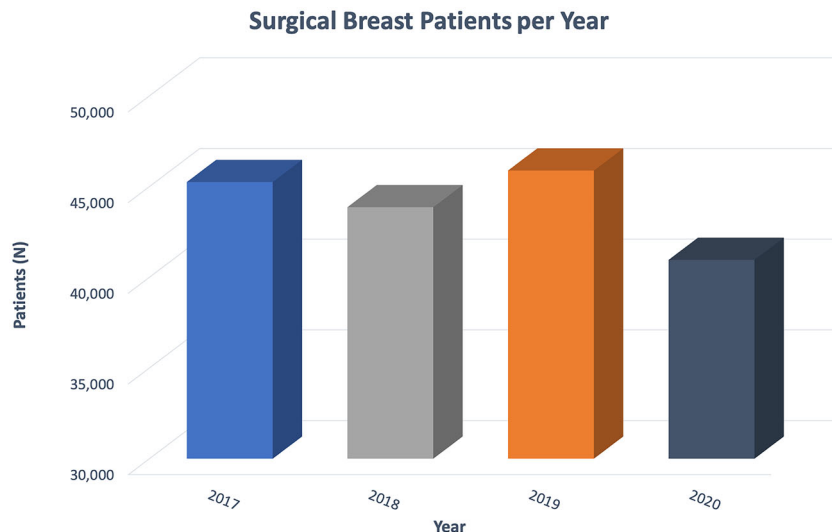


TABLE 1 Trends in mastectomy rates by type, immediate breast reconstruction rates, and autologous versus alloplastic (tissue expander, direct-to-implant) reconstruction rates (2017–2020)

Year	Total mastectomies	UM	CPM	BPM	No reconstruction	Immediate breast reconstruction	Autologous	Alloplastic		
								Alloplastic total	Direct-to-implant	Tissue expander
2017	16 390	70.8% (11 607)	26.4% (4328)	2.8% (455)	51.4% (8429)	48.6% (7961)	12.8% (1017)	87.2% (6944)	15.4% (1229)	71.8% (5715)
2018	16 423	72.3% (11 874)	24.7% (4051)	3.0% (498)	51.8% (8505)	48.2% (7918)	13.0% (1030)	86.9% (6888)	18.6% (1470)	68.4% (5418)
2019	17 237	70.5% (12 152)	26.7% (4597)	2.8% (488)	53.4% (9208)	46.6% (8029)	15.2% (1223)	84.8% (6806)	20.7% (1665)	64.0% (5141)
2020	15 713	71.9% (11 303)	25.7% (4035)	2.4% (375)	53.3% (8378)	46.7% (7335)	13.4% (981)	86.6% (6354)	18.2% (1338)	68.4% (5016)

Abbreviations: BPM, bilateral prophylactic mastectomy; CPM, contralateral prophylactic mastectomy; UM, unilateral mastectomy.

patients with hospitalization of 0 days increased from 9.6% to 25.9%, while the proportion of patients with hospitalization of 1 day decreased from 70.7% to 61.2% and decreased from 14.5% to 9.2% for patients hospitalized for 2 days ($p < 0.0001$).

When we compared 2019 versus 2020 basic patient variables for autologous reconstruction patients (see Table S5), we noted no significant differences in age, race, ethnicity, or ASA class. The mean operative time decreased from 481.9 min to 456.8 min (median operative time: 2019, 476 min; 2020, 446.5 min; $p = 0.001$). Inpatient autologous reconstruction rates did not change (95% in 2019 and 2020); however, when examining the length of hospital stay, there was an increase in the proportion of patients staying for ≤ 3 days and a decrease in the proportion of patients staying for ≥ 4 days ($p < 0.0001$).

4 | DISCUSSION

Our analysis of the NSQIP data sets from 2017 to 2020 provides initial insight on the impact of the first year of the COVID-19 pandemic on surgical volume and procedure characteristics for breast cancer patients. The proportion of female patients undergoing surgical treatment for breast cancer dropped by nearly 11% in 2020. Interestingly, lumpectomy and mastectomy rates remained stable, even with the ACS's initial recommendation to use BCT when possible; breast reconstruction rates also remained stable, though a higher proportion of patients underwent alloplastic reconstruction. Across procedures, outpatient surgery rates increased while the length of inpatient stay dramatically declined.

The 10.7% decline in the number of female surgical breast patients from 2019 to 2020 is notable as, historically, the volume of institutions participating in NSQIP has grown over time,¹⁴ but our finding is consistent with the literature. Hawrot et al.'s¹⁵ single-institution retrospective review comparing the treatment of early-stage breast cancer patients in 2020 with a pre-pandemic (2018) cohort reported an 18.8% decline in breast cancer patient volume. This large drop in the volume of surgical breast patients in 2020 indicates an overall decrease in breast cancer surgeries and screenings.¹⁵ Hawrot et al.¹⁵ also reported increased use of preoperative systemic therapy (hormonal therapy and chemotherapy), 43.9% in 2020 versus 16.4% in 2018 ($p < 0.001$), consistent with the ACS guidelines.

Despite the push toward less invasive procedures, our data demonstrate a decrease in lumpectomy rates and an increase in mastectomy rates. The slight increase in mastectomy rates may have been influenced by limited resources for radiation therapy or efforts to mitigate exposure to patients through multiple radiation therapy sessions.⁴ In addition, fewer patients may have been candidates for lumpectomy, as many cancers were detected by physical findings rather than routine imaging surveillance due to barriers in screening during the COVID-19 pandemic. However, the pre-pandemic (2017–2019) decrease in lumpectomy rates may be an indication of pre-existing changes in practice as well. Many studies have suggested avoiding prophylactic mastectomy procedures (CPM and BPM) and

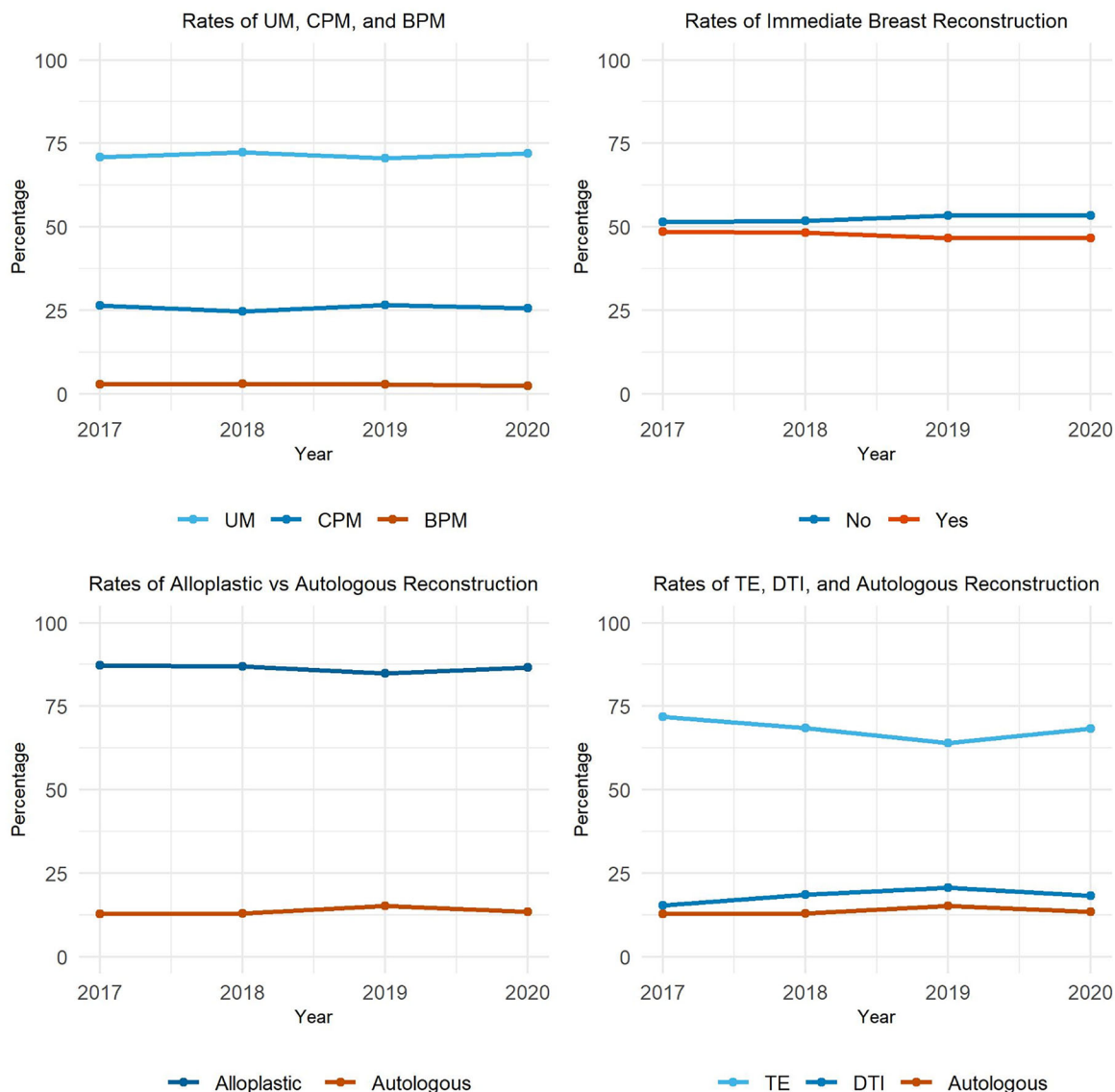


FIGURE 2 Trends in mastectomy rates by type, immediate breast reconstruction rates, and autologous versus alloplastic (tissue expander, direct-to-implant) reconstruction rates (2017–2020). BPM, bilateral prophylactic mastectomy; CPM, contralateral prophylactic mastectomy; DTI, direct-to-implant; TE, tissue expander; UM, unilateral mastectomy.

limiting surgery to breasts with an oncologic diagnosis to reduce operative times and postoperative complication risk.^{16,17} In accordance with ACS guidelines,¹⁰ we noted an increase in UM as compared with CPM and BPM; however, while this was statistically significant, it is unclear whether this increase is clinically profound, as our results do not suggest a drastic change in practice patterns. Rates of BPM remained low from 2019 to 2020, with a very slight decrease in the use of BPM (2.8% to 2.4%), suggesting that practices in BPM also did not change drastically due to the pandemic or ACS guidelines.^{4,9}

During the course of the COVID-19 pandemic and its impact at the geographic and institutional level, plastic surgeons adapted to ever-changing guidelines for reconstructive breast surgery. Notably, immediate breast reconstruction rates remained unchanged from 2019 to 2020, despite the restrictions imposed on plastic surgery and the limited staff and operating room resources available during the

pandemic. Immediate breast reconstruction rates have been shown to be higher in bilateral mastectomy procedures than in UM^{18,19}; however, we found that overall breast reconstruction rates were unaffected in the first year of the pandemic despite the slight decrease in CPM and BPM rates. Although the pandemic may have raised important considerations regarding the use of breast reconstruction,¹² the unchanged reconstruction rates from 2019 to 2020 highlight the value that breast cancer patients and physicians put on the benefits of breast reconstruction and the psychological concerns of not receiving reconstruction.^{20,21} A systematic review of the literature on breast reconstruction during the COVID-19 pandemic found many studies that recommended the continuation of postmastectomy breast reconstruction to reduce the buildup of patients requiring future reconstruction, potentially influencing the trends.¹²

	2019	2020	<i>p</i> value
Mastectomy type	No. 17 237	No. 15 713	
UM	70.5% (12 152)	71.9% (11 303)	0.003
CPM	26.7% (4597)	25.7% (4035)	
BPM	2.8% (488)	2.4% (375)	
Overall immediate breast reconstructions			
Yes	46.6% (8029)	46.7% (7335)	0.859
No	53.4% (9208)	53.3% (8378)	
Reconstruction type	No. 8029	No. 7335	
Autologous	15.2% (1223)	13.4% (981)	0.001
Alloplastic	84.8% (6806)	86.6% (6354)	
Reconstruction method (with alloplastic reconstruction type delineated)			
Autologous	15.2% (1223)	13.4% (981)	<0.0001
Direct-to-implant	20.7% (1665)	18.2% (1338)	
Tissue expander	64.0% (5141)	68.4% (5016)	

Abbreviations: BPM, bilateral prophylactic mastectomy; CPM, contralateral prophylactic mastectomy; UM, unilateral mastectomy.

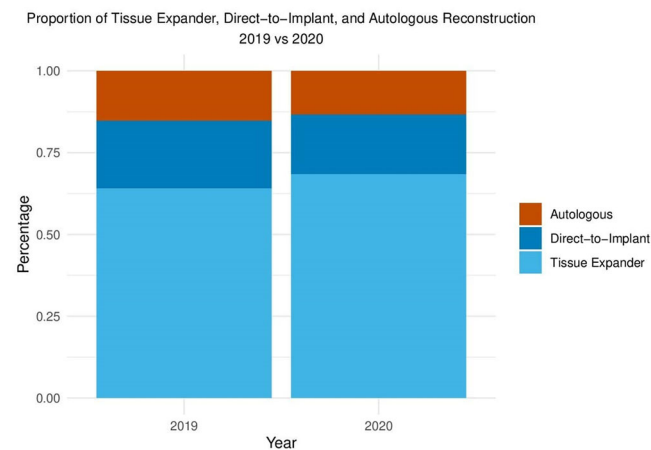


FIGURE 3 Proportion of tissue expander, direct-to-implant, and autologous reconstruction (2019 vs. 2020).

Delayed breast reconstruction was not examined in this study; however, it must be noted that pre-pandemic, delayed reconstruction was shown to be beneficial in certain high-risk patients, even demonstrating lower complication rates and similar patient-reported outcomes (PROs) as immediate reconstruction.^{22–24} As the ACS did not comment specifically on the usefulness of delayed reconstruction in high-risk patients, and we did not include delayed reconstruction in our analysis, it is unclear if rates of delayed reconstruction in certain high-risk patients were affected by the pandemic. Surgeons may have intentionally delayed reconstruction to postpone until after the resolution of the pandemic; however, the timing of COVID-19

TABLE 2 Procedure rates by type (2019 vs. 2020)

TABLE 3 Reconstruction by mastectomy type (2019 vs. 2020)

Mastectomy type	2019	2020	<i>p</i> value
UM	No. 4,645	No. 4,372	
Autologous	16.8% (781)	13.8% (603)	<0.0001
Alloplastic	83.2% (3864)	86.2% (3769)	
CPM	No. 2964	No. 2646	
Autologous	12.4% (367)	12.1% (319)	0.714
Alloplastic	87.6% (2597)	87.9% (2327)	
BPM	No. 420	No. 317	
Autologous	17.9% (75)	18.6% (59)	0.847
Alloplastic	82.1% (345)	81.4% (258)	

Abbreviations: BPM, bilateral prophylactic mastectomy; CPM, contralateral prophylactic mastectomy; UM, unilateral mastectomy.

resolution was unknown, potentially preventing optimal delayed reconstruction planning.

While alloplastic reconstruction rates remained higher than autologous reconstruction from 2017 to 2020, there was a notable decline in alloplastic reconstruction from 2018 to 2019; however, from 2019 to 2020, alloplastic reconstruction rates increased and autologous reconstruction rates decreased, underscoring the pandemic's influence on a reversal in recent breast reconstruction patterns (Figure 2). Multiple institutions developed protocols for addressing breast reconstruction during the COVID-19 pandemic, encouraging a multidisciplinary approach based on institutional

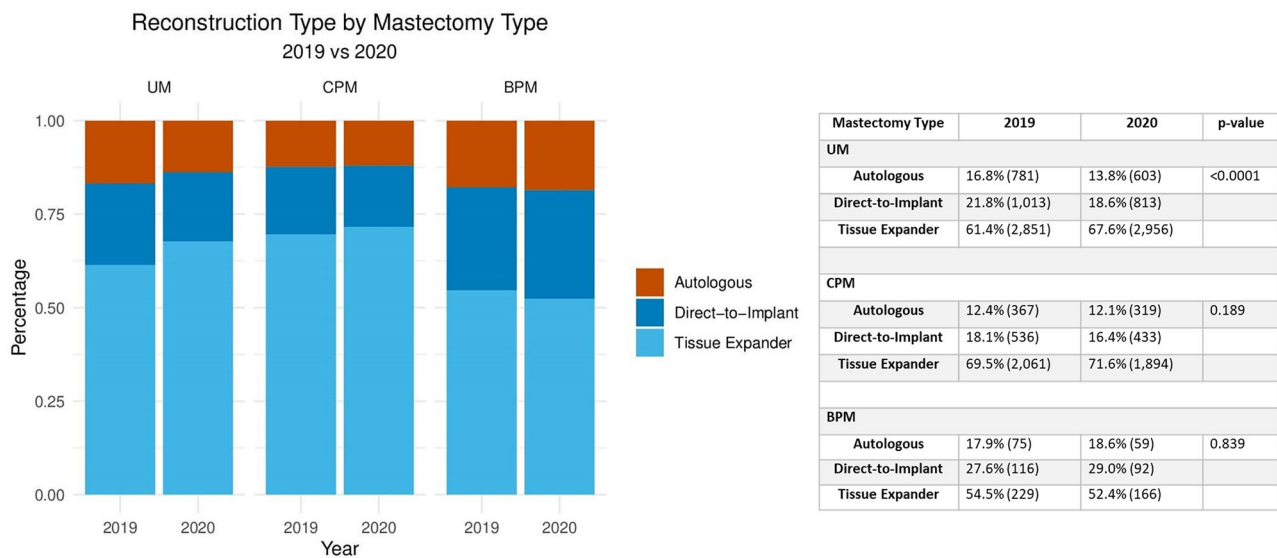


FIGURE 4 Reconstruction method (TE vs. DTI vs. autologous) by mastectomy type (2019 vs. 2020). DTI, direct-to-implant; TE, tissue expander.

support.^{25–32} Some focused on mastectomy without reconstruction or with implant-based reconstruction^{16,17,20,25,28,29,33}—initially deferring autologous reconstruction due to its association with increased operative times, use of resources, and hospital length of stay¹²—others reported the successful reintegration of autologous reconstruction.^{32,34,35} Of note, the ACS did not formally permit or encourage reintegration of autologous reconstruction; rather, as the pandemic progressed, guidelines encouraged surgical practices based on geographic COVID-19 burden and institution-specific resource availability. However, the decline in overall autologous reconstruction rates during the COVID-19 pandemic is clinically relevant for multiple reasons. Compared to autologous breast reconstruction, implant-based reconstruction has a higher infection risk due to the presence of a prosthesis, thus requiring more reoperations.^{12,21,36} Autologous breast reconstruction in clinically appropriate patients also has better PROs, which warrants further examination of the reconstructive trends to better understand the effects of COVID-19 on postmastectomy breast reconstruction PROs.^{12,37} Additionally, the significant decline in autologous reconstruction rates among UM patients with no significant change among CPM and BPM patients (Table 3 and Figure 4) suggests a relationship between bilateral mastectomy procedures and autologous reconstruction that persisted despite the pandemic.

In their systematic review examining breast reconstruction practices during the COVID-19 pandemic, Hemal et al.¹² demonstrated that among alloplastic reconstruction, DTI was favored over TE reconstruction due to the serial expansions and eventual second surgery associated with TEs. However, our data show decreased overall DTI reconstruction and increased TE reconstruction from 2019 to 2020 (Table 2 and Figure 3). As DTI eliminates the need for multiple office visits for TE expansion and exchange, it is interesting that DTI rates declined during the pandemic in our cohort. Physician

preferences, differing complication profiles, and patient need for adjuvant radiation therapy may have influenced this trend.³⁸ Alternatively, surgeons may have chosen to opt for the gold standard choice in alloplastic reconstruction, two-stage with TE placement at the time of mastectomy, during the pandemic due to its reliability. The slightly longer operative time for DTI may also have contributed to this decline in utilization. The most profound change in alloplastic reconstruction methods by mastectomy type from 2019 to 2020 was the significant increase in TE reconstruction in UM patients (61.4% to 67.6%, $p < 0.0001$), with no significant change in reconstruction patterns in CPM or BPM patients (Figure 4), reinforcing the concept that mastectomy patterns influence reconstruction patterns, even during the pandemic.¹⁹

The most notable difference between the 2019 and 2020 alloplastic reconstruction cohorts was a large increase in outpatient procedures and a decrease in hospital length of stay for the remaining inpatients (see Table S4). The most notable difference between the 2019 and 2020 autologous reconstruction cohorts was a decrease in hospital length of stay (see Table S5). To reduce COVID-19 exposure risk and decrease hospital burden, multiple institutions implemented protocols to shorten the length of stay and promote same-day discharge in breast reconstruction patients whenever possible, sometimes using modified enhanced recovery after surgery pathways or increased regional anesthesia.^{12,25–28,30,39} Our results reinforce that there was a push toward same-day surgery and shorter hospitalizations for all breast reconstruction patients during the first year of the COVID-19 pandemic. These new practice trends may potentially reduce hospital and patient costs in the future.³⁹ Although the length of stay decreased, the mean operative time for alloplastic procedures (DTI and TE) increased from 207.3 min to 212.9 min ($p = 0.0001$), which is a 2.7% increase. It is not completely apparent why this is the case, and while it is reasonable to suspect that

precautions around intubation and extubation, as well as limits on staffing, may have influenced the increase in operative time, this does not explain why operative times for autologous reconstruction decreased from 481.9 min to 456.8 min (5.2% decrease). Future studies may help clarify the impact of additional precautions on operative time during the early stages of the pandemic.

Our study has limitations related to using large national databases that merit discussion, including errors in data collection and reporting, as well as large sample sizes causing small differences of questionable significance to be highly statistically significant. Additionally, NSQIP does not specify the month of surgery, preventing the authors from tracking time-sensitive month-by-month changes in breast surgery rates throughout the pandemic. NSQIP is also a sample and may not be a complete representation of surgical case volume, as the pandemic may have impacted data collection for the program itself. While examining the geographic location and hospital type would be interesting, unfortunately, NSQIP does not provide such facility identifiers. Further examination using data sets such as NIS may be fruitful in the future to determine the impact of such variables. Participating NSQIP hospitals may include main facility operating rooms or ambulatory surgery centers. If participating centers included only the main facility, it is possible that both mastectomy or reconstruction counts may be lower given such a transition. Unfortunately, we are not able to determine if such changes occurred resulting in undercounts. In most situations, if a hospital submits cases to NSQIP, both ambulatory centers and main operating centers would be included in the submitted cases. Additionally, as NSQIP examines individual surgical cases rather than following each patient's care long term, we excluded delayed reconstruction trends from our study, as the interpretation of trends in delayed reconstruction during the pandemic is less straightforward than trends in immediate reconstruction. Despite these limitations in mind, our findings provide insight into possible areas for future research with institutional or additional epidemiologic data sets.

5 | CONCLUSION

Breast surgery volume declined by nearly 11% in 2020, the first year of the COVID-19 pandemic. While mastectomy and breast reconstruction rates were similar, alloplastic reconstruction was used more frequently and more commonly as an outpatient procedure. Across all forms of reconstruction, in-hospital time significantly decreased. As the severity of the pandemic fluctuates, the effects of COVID-19 will likely continue to influence breast surgery and reconstruction practice patterns.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are provided by ACS-NSQIP and are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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