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The Impact of COVID-19 on Breast Reconstruction: A Nationwide Analysis Utilizing NSQIP

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Abstract

Background The coronavirus disease 2019 (COVID-19) global pandemic prompted an unprecedented contraction in surgical volume. This utilizes the American College of Surgeons' National Surgical Quality Improvement Program (NSQIP) database to assess the impact of COVID-19 on breast reconstruction surgery volume and quality throughout 2020.

Methods The NSQIP database was utilized to gather data from 2015 to 2020. We provide descriptive statistics in the form of mean (standard deviation), median (interquartile range), and range for continuous variables and counts (%) for categorical variables. A Kruskal–Wallis test was used to compare average age and a chi-squared test was used to compare other demographic categorical variables from 2019 to 2020.

Results Breast reconstruction procedures decreased by 27% in Q2 2020 compared to Q2 of 2019. Immediate tissue-expander-based reconstruction was the only type of reconstruction that increased in comparison to Q2 2019 values (53.5 vs. 41.1%, $p < 0.001$). Rates of delayed direct to implant reconstruction was decreased (12.8 vs. 17.5%, $p < 0.001$) and free flap-based breast reconstruction decreased, including immediate free flap reconstruction (5.3 vs. 9%, $p < 0.001$) and delayed free flap reconstruction (5.7 vs. 9.1%, $p < 0.001$). Immediate direct to implant reconstruction rates were unchanged. In terms of surgical quality, there were no statistically significant increases in postoperative complications, readmissions, or reoperations.

Conclusion Breast reconstruction surgery was heavily impacted in Q2 of 2020 with a 27% decrease in total surgical volume. There was an increase in immediate tissue-expander-based reconstruction and decrease in rates of both direct to implant and free-flap based reconstruction. Surgical quality and outcomes remained unchanged through the pandemic.

Keywords
- reconstruction
- breast
- quality
- volume
- COVID-19

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As coronavirus disease 2019 (COVID-19) cases surged in the beginning of 2020, healthcare systems worldwide issued guidelines that impacted surgical practice. In the United States, the Center for Medicare and Medicaid Services (CMS) issued recommendations in March 2020 that introduced a tiered acuity system to guide which surgical procedures would be allowed to proceed during the pandemic.[1] Elective surgeries were postponed to reduce strain on hospital systems and mitigate COVID-19 spread; however, oncologic surgery, including mastectomy, was deemed high-acuity and necessary.[1] Despite mastectomy being considered an urgent procedure, no guidance was provided regarding postmastectomy reconstructive surgery. Postmastectomy reconstruction is an integral component of comprehensive breast cancer care, but there were concerns that immediate breast reconstruction could lead longer hospital stays—thus, more viral exposure and transmission—and increased postoperative morbidity, which could potentially expend resources needed for critically ill COVID-19 patients. Furthermore, strained staffing in areas of the hospital required for autologous reconstruction (postanesthesia care unit, intensive care unit, etc.) was also a concern.

Given the lack of comprehensive guidelines provided by CMS, the American Society of Plastic Surgeons (ASPS) released further recommendations regarding reconstructive surgery.[2,3] The ASPS recommended postponing autologous, delayed, and revision breast reconstruction until resumption of elective surgeries nationwide. They suggested that immediate implant-based breast reconstruction, oncoplastic reduction, and contralateral balancing procedures could be pursued on an individual basis based on a surgeon's assessment of exposure risk and resource availability.[2,3] This lack of clearly defined criteria led to uncoordinated breast reconstruction practices nationwide. Despite conflicting practice guidelines, an April 2020 survey of academic plastic surgeons revealed most respondents took a conservative approach to reconstruction, with only 35% offering implant-based reconstruction (IBR) and less than 10% offering immediate or delayed autologous reconstruction during the first wave of COVID-19 in March to April 2020.[4]

Since the beginning of the pandemic, several single institutions have described their experience with breast reconstruction during this timeframe, providing some insight into the impact of COVID-19 on breast reconstruction. Experiences from a Japanese academic medical center revealed that over 50% of reconstructive surgeries were postponed between April and July 2020, with the majority delayed at the surgeons' request due to risk of COVID-19 exposure.[5] In Canada, a national survey of plastic surgeons revealed that during the initial wave of COVID-19 between March and April 2020 survey respondents experienced a 78% decrease in volume of reconstructive surgery, with 27.4% reporting complete cessation of reconstructive surgery in their practice.[6] In the United States, institutions that proceeded with immediate IBR following mastectomy during the height of the pandemic reported complication rates similar to prepandemic levels and a preference for same-day discharge.[7]

While single-institution experiences and surveys of plastic surgeons have provided small-scale insight into the impact of COVID-19 on breast reconstruction,[4–7] few studies have been published providing a large, national-level investigation on the volume and quality of breast reconstruction during 2020. Hemal et al recently published a systematic review of the evidence available for surgeons during the COVID-19 pandemic.[8] This study differs in that we utilized the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database to assess the impact of COVID-19 on breast reconstruction surgical volume during each quarter of 2020 in comparison to 2019 prepandemic levels. We also investigate the quality of surgical care in 2020 by assessing postoperative complications, readmissions, and reoperations following breast reconstruction surgery during the pandemic.

Methods

Data Source

The ACS-NSQIP database from 2015 to 2020 was utilized for data collection. The ACS-NSQIP database is a Health Insurance Portability and Accountability Act-compliant national multi-institution prospectively collected database of surgical cases from participating hospitals. The number of participating hospitals varies per calendar year. Participating hospitals for the years relevant to our data analysis are as follows: 2020—706 hospitals, 2019—719 hospitals, 2018—722 hospitals, 2017—708 hospitals, 2016—680 hospitals, and 2015—603 hospitals.[9] The database contains aggregate patient-level data including demographics, comorbidities, perioperative variables, and 30-day postoperative outcomes. Information regarding the history of the NSQIP and data collection methods, data monitoring, and data validation have been previously described.[9] The ACS NSQIP and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors. This research protocol was reviewed by our institutional review board and given exempt status (IRB00068446).

Patient Selection

Current procedural terminology (CPT) codes were utilized to identify patients who underwent mastectomy and/or an index breast reconstructive procedure in the NSQIP-ACS database. Patients with any of the following CPT codes were included: mastectomy (19303-19307), tissue expander placement (19357), direct to implant reconstruction (19340), and free flap reconstruction (19364). Patients with CPT Code 19342 (insertion or replacement of breast implant on separate day as mastectomy) were excluded unless CPT 19342 was concurrent with CPT 11970 (removal of a tissue expander). We decided to exclude patients with only CPT Code 19342 because this CPT code may be used to bill for revision operations instead of the index reconstructive operation that would confound our analysis. Mastectomy with immediate breast reconstruction was defined as a

surgical encounter with concurrent mastectomy CPT code and any reconstructive CPT code. Delayed reconstruction was defined as an isolated reconstruction CPT code not preceded by a mastectomy CPT code. To distinguish between unilateral and bilateral reconstructions, we defined bilateral reconstruction as a surgical encounter with two of the same associated reconstruction CPT codes and unilateral reconstruction as a surgical encounter with only one associated reconstruction CPT code.

Outcome Variables

All included variables are defined per the ACS-NSQIP participant use data file.[9] Demographic variables, comorbidities, perioperative details, length of stay (LOS), and surgical setting were examined. Surgical setting was defined as outpatient or inpatient utilizing the NSQIP variable INOUT. Complications were defined by superficial incisional surgical site infection (SSI) (SUPINFEC), deep incisional SSI (WNDINFD), organ space SSI (ORGSPCSSI), wound disruption (DEHIS), unplanned intubation (REINTUB), pneumonia (OUPNEUMO), acute renal failure (OPRENAFL), urinary tract infection (URNINFEC), cardiac arrest (CDARREST), bleed requiring transfusion (OTHBLEED), sepsis (OTHSYSEP), and septic shock (OTHSESHOCK). Any readmission was defined by READMISSION1, and unplanned reoperation was defined by REOPERATION1.

Statistical Analysis

Data was broken down by quarters of the year with Q1 representing January to March, Q2 representing April to June, Q3 representing July to September, and Q4 representing October to December. We provide descriptive statistics in the form of mean (standard deviation), median (interquartile range), and range for continuous variables and counts (%) for categorical variables. A Kruskal–Wallis test was used to compare continuous variables and a Pearson chi-square or Fisher's exact tests were used to compare categorical variables from 2019 to 2020. A p-value less than 0.05 was deemed statistically significant. We performed all analyses using R version 3.6.1.

Results

Comparison of breast reconstruction patients between each admission quarter of 2019 and 2020 revealed similar patient demographics with regard to age, sex, body mass index (BMI), and history of diabetes. In Q2 of 2020, there was a smaller proportion of patients who identify as unknown/other race and a higher proportion of patients with a history of smoking in comparison to Q2 of 2019. Patients operated on in Q2, Q3, and Q4 of 2020 were on average of higher American Society of Anesthesiologists class than the patient cohorts in 2019, with the most significant difference evident in Q2 2020 ($p = 0.006$; ►**Table 1**).

The proportion of bilateral breast reconstructions performed was similar between all four quarters of 2019 and 2020, ranging from 32 to 37% of all reconstructions (►**Table 1**). The effects of COVID-19 on breast reconstruction surgery were most evident in Q2 of 2020, as demonstrated in ►**Table 2**. There was a 27% decrease in breast reconstruction procedures in Q2 2020 compared to Q2 2019. Further analysis by breast reconstruction type revealed an increase in immediate tissue-expander based reconstruction following mastectomy compared to Q2 2019 values (53.5 vs. 41.1%, $p < 0.001$). Immediate direct to implant reconstruction percentages were similar but expander-implant exchange was decreased in Q2 2020 (12.8 vs. 17.5%, $p < 0.001$). Autologous breast reconstruction overall was significantly decreased in Q2 2020 compared to Q2 2019, including immediate (5.3 vs. 9%, $p < 0.001$) as well as delayed reconstruction (5.7 vs. 9.1%, $p < 0.001$). Immediate IBR continued to favor tissue-expander based reconstruction as opposed to direct-to-implant reconstruction for the remainder of the calendar year. Autologous reconstruction volumes rebounded to 2019 levels in Q3 and Q4 2020.

►**Tables 3** and **4** provide insight into the postoperative outcomes for implant-based and autologous reconstruction, respectively. In Q2 of 2020, there was a statistically significant trend toward outpatient surgery for tissue-expander, direct to implant, and autologous reconstruction ($p < 0.001$, $p = 0.012$, and $p = 0.006$, respectively). With the transition to more outpatient-based procedures, there was no statistically significant increase in postoperative complication rates, readmissions, and unplanned reoperations.

Analysis of mean LOS from 2015 to 2020 reveals a downward trend in length of hospital admission following microvascular breast reconstruction over the past 5 years (►**Fig. 1**). In Q2 of 2020, there was a pronounced decrease in LOS following microvascular reconstruction compared to Q2 2019 (mean 3.313 vs. 3.725 days; ►**Table 5**). The mean LOS increased slightly for Q3 and Q4 of 2020 (3.560 and 3.553 days, respectively), but did not fully rebound to 2019 averages (►**Table 5**).

Discussion

Despite restrictions on surgical practice during the height of the COVID-19 pandemic in 2020, analysis of national breast reconstructive surgeries using the ACS-NSQIP database reveals that postmastectomy breast reconstruction continued to be offered throughout 2020 with no restriction on bilateral procedures. Although there was an 27% decrease in total breast reconstruction volume during April-June 2020, breast reconstruction surgical volume rebounded to prepandemic levels for the remainder of the calendar year.

While guidelines for postmastectomy breast reconstruction were vague and often recommended an individualized approach, assessment of surgical practice during 2020 showed a definite trend toward IBR. This trend is not surprising given ASPS guidelines during the height of the pandemic, in addition to the shorter operative time and possibility for outpatient surgery associated with IBR as opposed to autologous reconstruction.[10] Over 50% of breast reconstruction procedures between April and June 2020 were immediate tissue-expander placement. Immediate direct to implant reconstruction accounted for an additional

Table 1 Patient demographics by quarter of 2019 and 2020

	Q1 of 2019: $n = 3,179$	Q1 of 2020: $n = 3,364$	*p*-Value	Q2 of 2019: $n = 3,196$	Q2 of 2020: $n = 2,337$	*p*-Value
Mean age (SD)	50.9 (11.4)	50.8 (11.5)	0.56	51.1 (11.3)	50.8	0.30
Sex						
Female	3,174 (99.8%)	3,358 (99.8%)	1.00	3,189 (99.8%)	2,337 (100%)	0.06
Male	5 (0.2%)	5 (0.1%)	–	5 (0.2%)	0 (0%)	–
Nonbinary	0 (0%)	1 (0%)	–	2 (0.1%)	0 (0%)	–
Race						
Unknown/Other	648 (20.4%)	690 (20.5%)	0.91	673 (21.1%)	487 (20.8%)	**< 0.01**
Black/African American	299 (9.4%)	326 (9.7%)	–	291 (9.1%)	294 (12.6%)	–
White	2,232 (70.2%)	2,348 (69.8%)	–	2,232 (69.8%)	1,556 (66.6%)	–
BMI > 35	426 (13.5%)	437 (13%)	0.62	379 (11.9%)	301 (12.9%)	0.25
ASA class ≥ 3	841 (26.5%)	913 (27.1%)	0.53	823 (25.7%)	679 (29.1%)	**0.006**
History of diabetes	205 (6.4%)	183 (5.4%)	0.08	171 (5.3%)	143 (6.1%)	0.22
History of smoking	257 (8.1%)	247 (7.3%)	0.26	205 (6.4%)	184 (7.9%)	**0.036**
Bilateral breast reconstruction	1,101 (34.6%)	1,139 (33.9%)	0.51	1,050 (32.8%)	750 (32.1%)	0.56
	Q3 of 2019: $n = 3,263$	Q3 of 2020: $n = 2,938$	*p*-Value	Q4 of 2019: $n = 3,156$	Q4 of 2020: $n = 2,614$	*p*-Value
Mean age (SD)	51.4 (11.6)	50.8 (11.5)	0.044	51.2 (11.5)	51.2 (11.5)	0.84
Sex						
Female	3,262 (100%)	2,933 (99.8%)	0.11	3,150 (99.8%)	2,609 (99.8%)	1.00
Male	1 (0%)	5 (0.2%)	–	6 (0.2%)	5 (0.2%)	–
Nonbinary	0 (0%)	0 (0%)	–	0 (0%)	0 (0%)	–
Race						
Unknown/Other	654 (20%)	545 (18.6%)	**< 0.001**	659 (20.9%)	490 (18.7%)	0.06
Black/African American	299 (9.2%)	355 (12.1%)	–	340 (10.8%)	264 (10.1%)	–
White	2,310 (70.8%)	2,038 (69.4%)	–	2,157 (68.3%)	1,860 (71.2%)	–
BMI > 35	427 (13.1%)	417 (14.3%)	0.19	404 (12.9%)	345 (13.3%)	0.65
ASA class ≥ 3	939 (28.8%)	913 (31.1%)	**0.049**	903 (28.6%)	814 (31.1%)	**0.037**
History of diabetes	209 (6.4%)	187 (6.4%)	0.95	225 (7.1%)	153 (5.8%)	0.050
History of smoking	265 (8.1%)	205 (7%)	0.09	229 (7.3%)	164 (6.3%)	0.14
Bilateral breast reconstruction	1,131 (34.7%)	1,072 (36.5%)	0.13	1,139 (36.1%)	899 (34.4%)	0.17

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; Q, quarter; SD, standard deviation.
Note: Bold numbers indicate statistically significant values.

Table 2 Breast reconstruction volume by quarter of 2019 and 2020

Reconstruction type	Q1 of 2019: $n = 3,179$	Q1 of 2020: $n = 3,364$	*p*-Value	Q2 of 2019: $n = 3,196$	Q2 of 2020: $n = 2,337$	*p*-Value
Immediate TE placement	1,447 (45.5%)	1,597 (47.5%)	0.11	1,314 (41.1%)	1,250 (53.5%)	< **0.001**
Delayed TE placement	332 (10.4%)	274 (8.1%)	**0.001**	321 (10%)	218 (9.3%)	0.38
Immediate DTI	450 (14.2%)	471 (14%)	0.86	462 (14.5%)	349 (14.9%)	0.62
Delayed DTI	466 (14.7%)	537 (16%)	0.14	558 (17.5%)	299 (12.8%)	< **0.001**
Immediate autologous reconstruction	265 (8.3%)	265 (7.9%)	0.50	287 (9%)	125 (5.3%)	< **0.001**
Delayed autologous reconstruction	269 (8.5%)	273 (8.1%)	0.61	290 (9.1%)	133 (5.7%)	< **0.001**
Reconstruction type	**Q3 of 2019: $n = 3,263$**	**Q3 of 2020: $n = 2,938$**	***p*-Value**	**Q4 of 2019: $n = 3,156$**	**Q4 of 2020: $n = 2,614$**	***p*-Value**
Immediate TE placement	1,414 (43.3%)	1,316 (44.8%)	0.25	1,235 (39.1%)	1,087 (41.6%)	0.06
Delayed TE placement	307 (9.4%)	245 (8.3%)	0.14	284 (9%)	217 (8.3%)	0.35
Immediate DTI	452 (13.9%)	358 (12.2%)	0.052	462 (14.6%)	316 (12.1%)	**0.005**
Delayed DTI	549 (16.8%)	483 (16.4%)	0.68	630 (20%)	480 (18.4%)	0.12
Immediate autologous reconstruction	276 (8.5%)	236 (8%)	0.54	281 (8.9%)	242 (9.3%)	0.64
Delayed autologous reconstruction	321 (9.8%)	345 (11.7%)	**0.016**	310 (9.8%)	304 (11.6%)	**0.027**

Abbreviations: DTI, direct to implant reconstruction; Q, quarter; TE, tissue expander.
Notes: Bold numbers indicate statistically significant values. Immediate defined as reconstructive procedure performed concurrently with mastectomy; delayed defined as reconstructive procedure performed at a separate surgical encounter from mastectomy.

Table 3 Implant-based reconstruction characteristics and postoperative outcomes

Outcome	Tissue expander			Direct to implant		
	2019: $n = 1,639$	2020: $n = 1,470$	*p*-Value	2019: $n = 1,021$	2020: $n = 649$	*p*-Value
Unplanned reoperation	74 (4.5%)	46 (3.1%)	**0.045**	29 (2.8%)	21 (3.2%)	0.64
Unplanned readmission	112 (6.8%)	103 (7%)	0.85	56 (5.5%)	31 (4.8%)	0.53
Outpatient	1,089 (66.4%)	1,122 (76.3%)	< **0.001**	781 (76.5%)	530 (81.7%)	**0.012**
Complications						
Superficial SSI	37 (2.3%)	29 (2%)	0.58	24 (2.4%)	11 (1.7%)	0.36
Deep SSI	11 (0.7%)	12 (0.8%)	0.64	5 (0.5%)	3 (0.5%)	1.00
Organ/space SSI	33 (2%)	31 (2.1%)	0.85	12 (1.2%)	12 (1.8%)	0.26
Wound disruption	10 (0.6%)	13 (0.9%)	0.37	13 (1.3%)	4 (0.6%)	0.19
Unplanned intubation	1 (0.1%)	0 (0%)	1.00	0 (0%)	0 (0%)	1.00
Pneumonia	1 (0.1%)	1 (0.1%)	1.00	0 (0%)	0 (0%)	1.00
Acute renal failure	1 (0.1%)	0 (0%)	1.00	0 (0%)	0 (0%)	1.00
Urinary tract infection	2 (0.1%)	3 (0.2%)	0.67	5 (0.5%)	1 (0.2%)	0.41
Cardiac arrest requiring CPR	0 (0%)	0 (0%)	1.00	0 (0%)	0 (0%)	1.00
Blood transfusion	9 (0.5%)	15 (1%)	0.13	5 (0.5%)	2 (0.3%)	0.71
Sepsis	9 (0.5%)	8 (0.5%)	0.99	2 (0.2%)	1 (0.2%)	1.00
Septic shock	1 (0.1%)	0 (0%)	1.00	0 (0%)	0 (0%)	1.00

Abbreviations: CPR, cardiopulmonary resuscitation; SSI, surgical site infection.
Note: Transfusion intraop or postop.

Table 4 Autologous reconstruction characteristics and postoperative outcomes

Outcome	Free flap reconstruction		
	2019: $n = 577$	2020: $n = 258$	p-Value
Unplanned reoperation	35 (6.1%)	15 (5.8%)	0.89
Unplanned readmission	72 (12.5%)	34 (13.2%)	0.78
Outpatient	21 (3.6%)	21 (8.1%)	0.006
Complications			
Superficial SSI	35 (6.1%)	16 (6.2%)	0.94
Deep SSI	6 (1%)	4 (1.6%)	0.51
Organ/space SSI	6 (1%)	3 (1.2%)	1.00
Wound disruption	5 (0.9%)	0 (0%)	0.33
Unplanned intubation	1 (0.2%)	0 (0%)	1.00
Pneumonia	3 (0.5%)	0 (0%)	0.56
Acute renal failure	0 (0%)	0 (0%)	1.00
Urinary tract infection	0 (0%)	1 (0.4%)	0.31
Cardiac arrest requiring CPR	1 (0.2%)	0 (0%)	1.00
Blood transfusion	33 (5.7%)	23 (8.9%)	0.09
Sepsis	1 (0.2%)	2 (0.8%)	0.23
Septic shock	0 (0%)	0 (0%)	1.00

Abbreviations: CPR, cardiopulmonary resuscitation; SSI, surgical site infection.
Note: Transfusion intraop or postop.

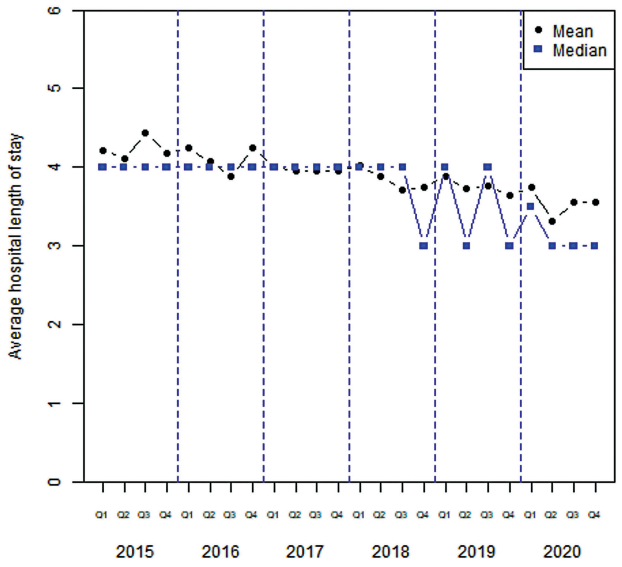

Fig. 1 Trend line of change in length of stay for autologous breast reconstruction by quarter between 2015 and 2020.

Table 5 Length of stay (LOS) per admission quarter for 2019–2020

Operative quarter	Mean LOS for all patients (days)
2019 Q1	3.882
2019 Q2	3.725
2019 Q3	3.763
2019 Q4	3.646
2020 Q1	3.747
2020 Q2	3.314
2020 Q3	3.560
2020 Q4	3.553

15% of the total volume. Although there was concern for a theoretical risk of greater postoperative morbidity or increased hospital stay with concurrent IBR and mastectomy, our results reveal no increased risk of postoperative complications, readmissions, or reoperations. A study by Huang et al utilizing the ACS-NSQIP database to compare women undergoing only mastectomy with those undergoing concurrent IBR also showed no increased incidence of 30-day postoperative bleeding or longer hospital stays in the immediate reconstruction cohort.[11] Immediate reconstruction allows for completion of surgical procedures in one hospital visit as opposed to two hospital admissions for delayed reconstruction, which allows for cost savings, conservative resource utilization, and a lower exposure risk to nosocomial viral spread.[10,12] Despite the safety and efficiency of pursuing immediate reconstruction during the pandemic era, it remains vital for reconstructive surgeons to continue to exert meticulous patient selection and risk stratification. Current guidelines recommend delayed reconstruction in patients greater than 70 years old, BMI more than 35, and/or

medical comorbidities including diabetes, chronic cardiac, or respiratory conditions.[10]

Our analysis revealed a statistically significant number of outpatient IBRs, with 76.3% of tissue expander cases and 81.7% of direct to implant cases coded as outpatient surgery. Importantly, this trend was not associated with any increase in readmissions, reoperations, or 30-day postoperative complications. This supports the feasibility of outpatient mastectomy and immediate IBR on a national scale previously shown in published pilot studies.[13–15] Outpatient reconstructive programs have been implemented at Georgetown University and Kaiser Permanente Northern California with no reported increase in postoperative emergency room visits, hospital readmissions, or unplanned reoperations.[13,14]

To facilitate discharge, several strategies have been utilized to minimize narcotic requirements including enhanced recovery after anesthesia (ERAS) protocols, liposomal bupivacaine blocks, and pectoral nerve blocks.[13–15] The safety of outpatient mastectomy and IBR has been demonstrated in an ambulatory surgery center setting, with no difference in complications noted compared to hospital setting.[15] Importantly, the vast majority of these programs have utilized prepectoral breast reconstruction, which is associated with less postoperative pain compared to the subpectoral approach.[13,15] Performing mastectomy and IBR on an outpatient basis has shown to have benefits for certain patients including improved psychosocial postoperative recovery, decreased utilization of hospital resources and cost, and decreased exposure to nosocomial infections.[13] The increase in outpatient breast reconstruction during the pandemic may revolutionize our current breast reconstruction paradigms for certain patients with it continuing to be a worthwhile and sustainable option postpandemic.

Analysis of autologous breast reconstruction revealed a significant decrease in autologous reconstruction volumes in Q2 of 2020, with a rebound to greater than 2019 levels during Q3 and Q4. There were no associated increases in postoperative morbidity, readmissions, or reoperations for the autologous reconstructions that were performed during the height of the pandemic. The safety of autologous reconstruction during the pandemic has been demonstrated at a single-institution level. A review of microvascular reconstruction during COVID-19 between June and December 2020 in the UK revealed that although fewer deep inferior epigastric perforator flap reconstructions were performed overall, there was no significant difference in ischemic time, unplanned reoperations, unplanned readmissions, or complications including infection, hematoma, seroma, or wound dehiscence, or flap failures.[16] Despite evidence of successful autologous reconstruction during the pandemic, the overall restriction of microvascular-based reconstruction seen on a national scale is consistent with prior published surveys of plastic surgeons within the United States. One survey revealed that survey respondents offered immediate or delayed autologous reconstruction in less than 10% of cases or on an individual basis in less than 15% during Q2 of 2020.[4]

LOS following microvascular reconstruction has been decreasing over the past 5 years, but during Q2 of 2020 the mean LOS was noticeably decreased at 3.314 days. Holoyda et al reported mean LOS nationwide for microvascular breast reconstruction decreased by 0.6 days between 2012 and 2018, with an estimated decrease of 0.1 days per year with no associated increase in postoperative morbidity or readmissions.[17] While the exact reasons for decreased LOS cannot be determined from a database, widespread implementation of ERAS protocols has likely contributed to this trend. A microvascular breast reconstruction-specific ERAS protocol was originally published in 2014 by Batdorf et al. In their study, implementation of the ERAS protocol led to a decrease in LOS for breast reconstruction patients from 5.5 to 3.9 days.[18] As ERAS protocols become more refined and widely adopted, patients will continue to achieve earlier postoperative recovery and discharge following microvascular reconstruction.

Despite the advantages of a national level database such as ACS-NSQIP, there are certain limitations of using this database that must be taken into consideration when evaluating our results. The NSQIP only captures 30-day outcomes; so, long-term and patient-reported outcomes cannot be accounted for and considered in terms of postoperative morbidity. Because of this, defining delayed reconstruction is difficult since multiple encounters cannot be tied together outside of 30 days. It is possible that the delayed cohort includes patients that did not receive oncologic resection prior to reconstruction, though this number is likely small. Even still, this would indicate a possible overestimation of breast reconstruction in this study, which means it may have dropped even further than assessed. We also did not directly compare outpatient IBR to inpatient autologous reconstruction, and therefore, cannot draw any conclusions directly comparing the two at this time. Additionally, while the NSQIP database does collect data regarding postoperative complications, it does not focus on plastic-surgery specific outcomes of interest, such as seroma, hematoma, and donor site morbidity. Given that the national database relies on self-reported data from participating hospitals, there is the possibility of coding misclassification for procedures and diagnoses as well as under-reporting of data, which may confound our analyses. Overall, however, large-scale data provided by the ACS-NSQIP allows for an unprecedented look into the impact of COVID-19 on breast reconstruction surgery in the United States.

Conclusion

Breast reconstruction surgery was most heavily impacted in Q2 of 2020, with a 27% decrease in surgical volume. There was a clear trend toward immediate tissue-expander based reconstruction in Q2 that continued through the rest of the calendar year with an inverse drop in both direct to implant reconstruction and autologous reconstruction over the same time frame. Decreased LOS and increased outpatient surgical procedures during the pandemic were not associated with any decrease in surgical quality or patient outcomes.

Conflict of Interest
None declared.

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