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Autologous Breast Reconstruction is Associated with Lower 90-day Readmission Rates

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Background: Breast reconstruction is associated with improved quality of life after mastectomy. Options for breast reconstruction include autologous and implant-based methods. Although autologous reconstruction is more technically challenging and requires longer operative time, it is thought of as the gold standard. Our study examined differences in 90-day readmission rates between implant-based and autologous breast reconstruction using discharge data from the National Readmission Database, Healthcare Cost and Utilization Project, and Agency for Healthcare Research and Quality.

Methods: The National Readmission Database was used to identify patients undergoing postmastectomy breast reconstruction. Patients were selected using ICD-10 PCS codes linked to autologous and implant-based reconstruction. Ninety-day readmission rates were determined. After matching the two groups on a 1:1 basis for baseline comorbidities and demographics, a multivariable logistic regression analysis was performed to variables associated with higher readmission rates.

Results: The leading diagnoses associated with readmissions were infectious and pulmonary. After one to one matching, autologous breast reconstruction, private insurance versus Medicaid, and income quartile 4 versus 1 were all less likely to be readmitted within 90 days of discharge. Patients with a high Charlson index and those with a longer length of initial hospital stay are significantly more likely to be readmitted within 90 days.

Conclusions: Patients undergoing autologous breast reconstruction were 23% less likely to be readmitted within 90 days from discharge. Fewer comorbidities, shorter length of hospital stay, and higher socioeconomic status are also associated with lower readmission rates following breast reconstruction. *(Plast Reconstr Surg Glob Open 2022;10:e4112; doi: 10.1097/GOX.0000000000004112; Published online 15 February 2022.)*

INTRODUCTION

Breast cancer is the most common cancer among women and the second leading cause of cancer death behind lung cancer in the United States.[1] Despite advancements in pharmacological treatments for breast cancer, total or sub-total mastectomy remains a mainstay of treatment. Approximately 40% of breast cancer patients will undergo a mastectomy.[2] Furthermore, the rates of risk-reducing bilateral mastectomy procedures have dramatically increased in recent years.[3] Similarly, rates for breast reconstruction in women following a mastectomy have increased from 11.6% in 1998 to 36.4% in 2011.[4] The benefits of breast reconstruction are numerous, including increased self-esteem, quality of life, patient satisfaction, and psychosocial well-being.[5,6]

Breast reconstructions fall into two categories: implant-based or autologous, and in some cases a combined approach. Implant-based reconstruction rates increased by an average of 11% per year between 1998 and 2008 and surpassed autologous reconstructions in 2002.[7] Implant-based reconstructions use saline or silicone implants and are shorter, less invasive procedures without donor site morbidity. Autologous reconstructions tend to be more complex and require longer operations but are associated with superior long-term aesthetic satisfaction and increased psychosocial and sexual well-being.[8,9] Despite these advantages, rates of autologous breast reconstruction remain stagnant.[7] This may be related to Medicare reimbursements for breast reconstruction, as from 2000 to 2010, the rates for tissue-based procedures declined

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significantly, but rates for implant procedures remained stable.[10]

With the passage of the Patient Protection and Affordable Care Act, the Hospital Readmissions Reduction Program was created, placing emphasis on reducing excess readmissions for Medicare patients. Hospitals with above-average 30-day readmission rates will receive reduced Medicare reimbursements for certain high-volume procedures, although breast reconstruction has not yet been affected by this policy.[11] Previous research found no significant difference in the 30-day readmission rates between implant-based and autologous breast reconstruction.[12] Interestingly, a recent study found that a majority of infectious readmissions from breast cancer patients undergoing reconstruction with implants and tissue expanders occurred after 30 days from the initial surgery.[13] Since infections have been reported to occur in up to 35% of implant-based breast reconstructive surgeries and are a predictor of readmission, the traditional 30-day readmission rates are an insufficient quality metric to compare breast reconstruction techniques.[12–14]

In light of the importance of reducing hospital readmissions, our study examined differences in 90-day readmission rates between implant-based and autologous breast reconstruction using discharge data from the National Readmission Database (NRD), Healthcare Cost and Utilization Project, and Agency for Healthcare Research and Quality. We hypothesized that after controlling for baseline patient characteristics and baseline comorbidities, autologous breast reconstruction would be associated with lower 90-day readmissions when compared with implant-based reconstruction.

METHODS

The NRD was used to identify patients who underwent breast reconstruction based on International Classification of Disease 10 Procedure Coding System (ICD-10-PCS) between the years 2016 and 2017, which was the most recent dataset available using the ICD-10 system. Cases involving combined implant-based and autologous-based reconstruction were excluded. The Springfield Committee for Research in Human subjects deemed this study non-human subjects research, and thus no institutional review board approval was needed.

Takeaways

Question: Is autologous breast reconstruction associated with lower rates of 90-day readmissions compared to implant-based reconstruction?

Findings: After matching for baseline characteristics and comorbidities, autologous breast reconstruction was associated with a 23% decrease in 90-day hospital readmission.

Meaning: Patients undergoing autologous breast reconstruction may be less likely to be readmitted to the hospital within 90 days of surgery than those undergoing implant-based reconstruction.

The NRD contains discharges for all payers and the uninsured, including 2,000 hospitals in 22 states. The database recognizes readmissions to participating facilities. Codes used to identify autologous and implant-based breast reconstruction are present in Table 1. The leading diagnoses associated with 90-day readmissions for all patients were identified. The patients were then matched 1:1 based on age, payer type (Medicare, Medicaid, private/self-pay, other), diagnosis of diabetes mellitus (complicated and uncomplicated), obesity, and Charlson comorbidity index of 0, 1–2, and greater than 3, which accounts for multiple baseline comorbidities and aids in prediction of 10 year survival in the setting of chronic disease. A Charlson index of 2 was compared with that of 1, and an index of 3 was compared with that of 2. Our intent with this matching process was to allow an even comparison of autologous versus implant-based procedures, realizing that implant procedures are performed more frequently in the general population. After the cases were matched, weights were applied. The weights are applied on an individual basis and the range of possible weight values is varied. The weighting accounts for the difference in the number of cases in the two groups.

A multivariable logistic regression analysis was then performed, taking into account the aforementioned confounding variables. Probability of readmission within 90 days was calculated using odds ratios with P values less than 0.05 considered significant. A multivariable logistic regression analysis was then repeated considering

Table 1. ICD-10 Procedure Coding System Codes* for Autologous and Implant-based Breast Reconstruction

Autologous-based Procedure Codes	Procedure	Implant-based Procedure Codes	Procedure
0HRT076	Right TRAM	0HRT0JZ	Replacement of breast with synthetic substitute, open approach, right
0HRT077	Right DIEP	0HRU0JZ	Replacement of breast with synthetic substitute, open approach, left
0HRT078	Right SIEA	0HRV0JZ	Replacement of breast with synthetic substitute, open approach, bilateral
0HRT079	Right GAP	0HRT0KZ	Replacement of breast with nonautologous tissue substitute, open approach, right
0HRU076	Left TRAM	0HRU0KZ	Replacement of breast with nonautologous tissue substitute, open approach, left
0HRU077	Left DIEP	0HRV0KZ	Replacement of breast with nonautologous tissue substitute, open approach, bilateral
0HRU078	Left SIEA	0HRT3JZ	Replacement of breast with synthetic tissue substitute, percutaneous approach, right
0HRU079	Left GAP	0HRU3JZ	Replacement of breast with synthetic tissue substitute, percutaneous approach, left
0HRV076	Bilateral TRAM	0HRV3JZ	Replacement of breast with synthetic tissue substitute, percutaneous approach, bilateral
0HRV077	Bilateral DIEP	0HRT3KZ	Replacement of breast with nonautologous tissue substitute, percutaneous approach, right
0HRV078	Bilateral SIEA	0HRU3KZ	Replacement of breast with nonautologous tissue substitute, percutaneous approach, left
0HRV078	Bilateral GAP	0HRV3KZ	Replacement of breast with nonautologous tissue substitute, percutaneous approach, bilateral

*The codes are used to identify implant-based and autologous breast reconstructions.

Table 2. Leading Diagnoses for Autologous and Implant-based Breast Reconstructions

| | | Top Five Primary Diagnoses for 90-day Readmissions | | | | | |
| | | All | | Autologous | | Implant | |
Description	Code	Count	Percentage	Count	Percentage	Count	Percentage
Infection following a procedure, initial encounter	T814XXA	288	21.69	165	25.65	122	17.93
Infection and inflammatory reaction due to other internal prosthetic devices, implants and grafts, initial encounter	T8579XA	213	16.04	56	8.70	157	22.99
Disruption of external operation (surgical) wound, not elsewhere classified, initial encounter	T8131XA	31	2.03	15	2.40	16	2.29
Other pulmonary embolism without acute corpulmonale	I2699	32	2.38	24	3.69	8	1.16
Sepsis, unspecified organism	A419	25	1.92	16	2.48	9	1.39

The table contains the leading five readmission diagnoses and their associated ICD-10 codes for autologous and implant-based breast reconstructions.

the aforementioned confounding variables, this time separating the implant and autologous-based reconstruction groups to examine differing causes of readmission between the two groups.

RESULTS

A total of 15,325 cases of breast reconstructions were identified and matched: 7509 implant-based and 7816 autologous-based. The overall readmission rate for the entire cohort before 1:1 matching was 8.7%. Of the 7509 patients who had implant-based breast reconstruction, 681 (9.06%) were readmitted within 90 days, whereas 654 of 7816 (8.4%) patients who underwent autologous reconstruction were readmitted. The most common diagnoses associated with readmissions were infection-related and pulmonary embolism (Table 2). There were no significant differences between the two groups regarding several baseline characteristics, including age, obesity, diabetes, payer type, and Charlson score after matching (Table 3). After one-to-one matching, autologous breast reconstruction (OR 0.770, CI 0.638–0.931), private insurance versus Medicaid (aOR 0.691, CI 0.538–0.887), and income quartile 4 (aOR 0.750, CI 0.591–0.952) were all less likely to be readmitted within 90 days of discharge (Table 4). Patients with a high Charlson index (aOR 1.221, CI 1.076–1.386) and those with longer length of initial hospital stay (aOR 1.090 per 1-day increase, CI 1.040–1.143) were significantly more likely to be readmitted within 90 days (Table 4).

DISCUSSION

The ratio of breast reconstructions to mastectomies increased 67% from 24 to 40 breast reconstructions per 100 mastectomies between 2009 and 2014.[15] Research has shown that patients undergoing breast reconstruction are more satisfied and have a greater quality of life.[5,6] Yang et al. found a significant increase in immediate breast reconstruction after the implementation of the Women's Health and Cancer Rights Act (WHCRA) in 1998 which mandated that insurers cover breast reconstruction procedures.[16,17] With the newly placed emphasis on quality improvement and readmission rates with the passage of the Patient Protection and Affordable Care Act, predicting and minimizing readmissions will be important for both patient safety and in terms of reimbursement. Mlodinow and colleagues examined factors influencing 30-day readmission rates after breast reconstruction using the National Surgical Quality Improvement Program database and found similar readmission rates between autologous and implant-based breast reconstruction.[12] However, recent literature suggests that approximately half of infections and the majority of explantations following prosthetic breast reconstruction occur in the late postoperative period, between 31 and 90 days; so the traditional 30-day readmission rate may not include a substantial number of readmissions from infectious etiologies.[13] The present study encompasses 15,325 cases and is the largest multi-institution analysis comparing 90-day readmissions between prosthetic and autologous breast reconstructions using data for the NRD.

The 90-day readmission rate for the entire cohort was 8.7%, and patients with autologous reconstructions were readmitted at a rate of 8.4%, while patients with prosthetic reconstructions were readmitted at a rate of 9.06%. These rates were higher than the previously reported 30-day readmission rates for autologous and prosthetic reconstructions: 5.32% and 4.34%, respectively.[12] Additionally, studies by Mlodinow et al and Mioton et al found the autologous reconstruction cohort to be associated with higher 30-day reoperation rates and overall complication rates.[12,18] These observed differences in 30-day and 90-day readmission rates may in part be attributed to additional readmissions that occurred after 30 days from the initial surgery, specifically infectious readmissions of prosthetic reconstructions. Collier et al reported that 50.1% of infections from prosthetic reconstructions occurred in the late postoperative period, between days 31 and 90 postoperatively. Furthermore, a majority of prosthetic explantations (55.1%) occurred in the late postoperative period.[13] Similarly, Cohen et al found that only approximately half of the explantations occurred within 30 days of the initial operation and 9% occurred more than 100 days later with a mean time of explantation of 41 days.[19] Together, these findings suggest that previous literature evaluating morbidity outcomes and readmissions inadvertently excluded a substantial number of late infections, complications, and reoperations that occurred after 30 days, which potentially resulted in erroneous conclusions that autologous reconstructions are associated with higher rates of readmission, complications, and reoperation rates.

The advent of the deep inferior epigastric perforator flap enabled raising large flaps without significant donor site morbidity, as seen in a transverse rectus abdominis flap, which violates the rectus muscle, and thus results in

Table 3. Matched 90-day Readmission Groups

	Autologous (N = 7816)		Implant (N = 7509)		*P*
	Number	Percent	Number	Percent	
Age group					0.9710
40 and under	1370	17.53	1363	18.15	
41–50	2322	29.71	2205	29.36	
51–60	2266	28.99	2174	28.95	
61–70	1487	19.03	1415	18.84	
Over age 70	371	4.75	352	4.69	
Obesity	641	8.20	625	8.32	0.8493
Diabetes (uncomplicated)	363	4.64	372	4.95	0.5483
Diabetes (complicated)	92	1.18	90	1.20	0.9574
Payer type					0.9749
Medicare	1305	16.70	1261	16.79	
Medicaid	763	9.76	740	9.85	
Private/self-pay	5574	71.32	5331	70.99	
Other	173	2.21	177	2.36	
Charlson score					0.2515
0	3168	40.53	2940	39.15	
1–2	3278	41.94	3154	42.00	
3 and over	1369	17.52	1415	18.84	

The table demonstrates the implant-based and autologous groups after 1:1 matching by multiple baseline characteristics.

greater morbidity at the donor site.[20] Autologous reconstruction using the deep inferior epigastric perforator flap has been referred to as the gold standard of breast reconstruction using abdominal tissue.[21]

Compared with women who underwent prosthetic reconstructions, studies have shown autologous reconstructions are associated with greater breast satisfaction and increased psychosocial and sexual well-being.[9,22] Nelson et al demonstrated that patients with autologous reconstructions have greater postoperative satisfaction and health-related quality of life compared with prosthetic reconstructions at 1, 3, 5, and 7 years following surgery.[23] Moreover, it has been reported that DEIP flap reconstructions result in fewer serious complications and are more cost-effective long-term compared with prosthetic reconstructions, especially when considering quality of life.[24,25] Despite the benefits of autologous reconstructions, these procedures have been associated with longer operative times and longer hospital stays.[26]

Infectious causes were the leading diagnosis of 90-day readmissions in both cohorts (Table 2). Similarly, Mlodinow et al reported that surgical site infection was the leading complication in readmitted and the second most common complication in the nonreadmitted cohorts.[12] Others have shown that infectious complications are the most common cause of surgical readmissions.[27] In our analysis, pulmonary embolism was the second leading diagnosis for autologous reconstructions, occurring in 3.67% of the readmitted patients. Previous studies have established that immediate breast reconstruction is associated with an additional risk of postoperative venous thromboembolism compared with mastectomy alone. Similarly, autologous reconstructions have been shown to predict greater odds of venous thromboembolism than prosthetic reconstructions.[28]

After controlling for an array of baseline characteristics by matching the two cohorts on a 1:1 basis, we have demonstrated that patients undergoing implant-based reconstructions were 23% more likely to be readmitted within 90 days than patients undergoing autologous-based reconstruction. This finding has not yet been reported in the literature to our knowledge. Decreased rates of readmission may

Table 4. Multivariable Logistic Regression Analysis for All 90-day Readmissions Cases

Variable	Adjusted Odds Ratio	Interpretation
Autologous versus implant	0.770 (0.638–0.931)	Autologous patients less likely to be readmitted
Charlson index	1.221 (1.076–1.386)	Higher Charlson group more likely to be readmitted
Obesity	1.205 (0.911–1.592)	Not Significant
Age group	1.022 (0.929–1.124)	Not Significant
Medicaid versus medicare	0.733 (0.515–1.042)	Not Significant
Medicaid versus private	0.691 (0.538–0.887)	Private less likely to be readmitted
Medicaid versus other	0.776 (0.442–1.327)	Not Significant
Income quartile 2 v 1	0.876 (0.672–1.143)	Not Significant
Income quartile 3 v 1	0.790 (0.608–1.027)	Not Significant
Income quartile 4 v 1	0.750 (0.591–0.952)	Higher income quartile less likely to be readmitted
Teaching versus nonteaching	1.017 (0.813–1.273)	Not Significant
Hospital bed size	1.016 (0.909–1.136)	Not Significant
Rural versus urban	1.075 (0.874–1.323)	Not Significant
Diabetes (uncomplicated)	1.102 (0.759–1.600)	Not Significant
Diabetes (complicated)	1.212 (0.661–2.221)	Not Significant
Hypertension	1.225 (1.000–1.500)	Not Significant
Chronic lung disease	1.201 (0.894–1.613)	Not Significant
Length of stay	1.090 (1.040–1.143)	Longer length of stay more likely to be readmitted

The table contains the results of a logistic regression analysis performed on all included patients with 90-day readmissions to identify variables associated with 90-day readmission after breast reconstruction.

therefore be an additional benefit of autologous breast reconstruction compared with implant-based reconstruction. Ultimately, patient preference and shared decision-making in partnership with their physician should guide the selection of breast reconstruction options.

In addition to autologous reconstruction, we also identified private insurance, lower Charlson index, higher income, and shorter length of hospital stay to be associated with lower 90-day readmission rates (Table 4). Literature suggests that socioeconomic status influences decisions with breast reconstruction.[29,30] Christian and colleagues found that education level, employment, and insurance influenced the use of breast reconstruction, and women with private insurance, higher education levels, or employment outside the home were more likely to undergo reconstruction.[29] In addition, Chouairi et al found that women with private insurance were more likely to undergo autologous reconstruction, but women with Medicaid and Medicare were more likely to undergo prosthetic reconstruction.[30] Although there is a paucity in the literature regarding the association of socioeconomic status and breast reconstruction readmissions, previous work has shown that income inequality is associated with higher readmission rates in heart failure, myocardial infarction, and pneumonia.[31] Readmission following lung lobectomies has also been found to be influenced by median household income and insurance status.[32]

Although this study is the largest multi-institution analysis evaluating 90-day readmissions between breast reconstruction techniques, there are limitations. The NRD only records inpatient data. Outpatient prosthetic reconstructions and any postoperative complications that present to other hospital systems, urgent care centers, or outpatient clinics are not included. Any complications and subsequent readmissions that occur after 90 days are not included. Additionally, the study cannot account for individual medical details such as the timing of the reconstruction in relation to the mastectomy, medications predisposing patients to bleeding or infections, or underlying undiagnosed conditions.

CONCLUSIONS

Autologous breast reconstruction comes with a multitude of advantages when compared with implant-based breast reconstruction, despite the procedure's increased technical complexity and operative time. We have demonstrated that after controlling for baseline health and socioeconomic status, autologous breast reconstruction, in addition to private health insurance and higher income, was associated with lower rates of 90-day readmission. Increased Charlson index and longer hospital stay, on the other hand, were associated with a greater risk of 90-day readmission.

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