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An Evaluation of the Impact of Mental Illness on Postoperative Breast Reconstruction Revision Surgery

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Background: Breast cancer impacts millions of people yearly affecting various aspects of their lives—including but not limited to mental health. Patients with a known psychiatric history, specifically generalized anxiety disorder (GAD) and/or depression, have previously been shown to have an increased number of revisions after breast reconstruction.

Methods: A commercially available database of 91 million unique patients, PearlDiver, was used to identify patients with breast cancer who underwent autologous free flap breast reconstruction. An average number of revisions were calculated from each group of patients—those with a history of anxiety and/or depression and patients without a history of anxiety and/or depression. A logistic regression was performed to determine risk factors associated with patients undergoing revision surgery.

Results: A total of 39,683 patients with a history of breast cancer underwent autologous breast reconstruction between 2010 and 2020, of which 6308 (15.9%) patients had a history of GAD and/or depression before autologous reconstruction. A total of 13,422 (33.8%) patients received at least one revision surgery. Patients with GAD only, depression only, and concomitant GAD and depression received 1.40 revisions each with no significant differences between the control and any of the study groups ($P = 0.956$). Logistic regression did not find psychiatric history to be associated with patients undergoing revision surgery (OR, 0.94; 95% CI, 0.89–1.00).

Conclusion: Patients who underwent autologous reconstruction for breast cancer demonstrated no difference in rates of secondary surgical revision, regardless of a concurrent mental health history. *(Plast Reconstr Surg Glob Open 2023; 11:e4739; doi: 10.1097/GOX.0000000000004739; Published online 6 January 2023.)*

INTRODUCTION

Breast cancer is the most common cancer among women worldwide, with approximately one in eight women diagnosed with breast cancer in their lifetime.[1] Diagnosis and treatment of breast cancer can have profound implications on a woman's quality of life. Breast reconstruction is part of this treatment and has been shown to significantly improve patient satisfaction and psychological well-being.[2] The main reasons patients elect to undergo reconstruction include but are not limited to aesthetics, improved overall self-esteem, feeling of overcoming cancer, and more clothing choices.[3,4] In addition to primary reconstructive surgery, many women will elect to undergo additional revisional procedures to improve the outcome of the reconstruction.[5]

Unfortunately, many women experience mental health disturbances or illness before or during their breast cancer diagnosis, and this has been shown to adversely affect cancer treatment outcomes.[6] Mental health conditions have been shown to contribute to poorer outcomes, with up to a 39% higher mortality in cancer patients.[7–9] Furthermore, specific mental health comorbidities, such as anxiety and depression, have been found to be among the strongest predictors for hospice use, increased ambulatory visits, increased annual hospitalizations, and increased number of bedbound days in certain cancer types.[10] In general, anxiety and depression have been shown to negatively impact self-body image and may be present in up to 38.2% of breast cancer patients.[11] In a large systematic review covering evidence on adverse mental health outcomes in breast cancer survivors, 17 of 21 studies showed higher rates of anxiety with 11 being statistically significant among breast cancer survivors compared with their control populations, and 33 of 38 studies demonstrated

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more depression with 19 being statistically significant. Breast cancer survivors were also observed to have statistically significant increased symptoms/frequency of sexual dysfunction, sleep disturbances, stress-related disorders/posttraumatic stress disorder, neurocognitive dysfunction, bipolar disorders, obsessive compulsive disorders, and suicide.[12] Given the high rates of concomitant mental health issues, it is important to assess the impact that this may have on the number of revisions after autologous breast reconstruction surgery. Few studies have previously focused on postoperative surgical revision rates for associated mental health disorders in breast reconstruction in cancer patients. Should an association exist, this information would be beneficial in the context of preoperative guidance and support for patients undergoing breast reconstruction.

Current recommendations suggest screening for psychiatric disorders for prospective cosmetic surgery patients; however, no current recommendations exist for oncologic patients undergoing plastic surgery, especially breast cancer. Breast reconstruction is a longitudinal process often requiring multiple procedures and revisions. Since revisions are often pursued for cosmetic purposes, we hypothesized that patients with comorbid psychiatric conditions would undergo more revisions than those without such comorbidities.

The purpose of this study was to utilize a large insurance claims database to analyze the effect that mental health can have on the number of revisions after autologous breast reconstruction in patients with a history of breast cancer. We hypothesize that patients with generalized anxiety disorder (GAD) and/or depression will have a higher number of average revisions when compared with patients without such psychiatric comorbidities.

MATERIALS AND METHODS

STROBE Guidelines

The STROBE guidelines for observational studies were followed in the design of this study and manuscript. This is a retrospective cohort study comparing two groups of patients undergoing autologous breast reconstruction—patients with a history of GAD and/or depression before reconstruction and patients without a documented psychiatric illness. Below, all elements of the design study are detailed per the guidelines.

Study Population

Data were obtained from the PearlDiver database (PearlDiver Technologies, Colorado Springs, Colo.), a commercially available insurance claims database and research platform that consists of 91,000,000 unique patients in the United States. Data are gathered from mostly commercial insurance companies, although CMS data are also included, and patient-level data are tracked longitudinally over a 10-year span from January 1, 2010 to October 30, 2020. Patients are grouped by diagnosis, procedural, and drug coding associated with each encounter, clinical, and procedural. The strengths of this database

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<p style="text-align:center; color:#90308f;">Takeaways</p>

Question: Does a preexisting psychiatric diagnosis increases the number of revision procedures a patient receives after autologous breast reconstruction?

Findings: Patients with preoperative diagnosis of major depressive disorder and or generalized anxiety do not experience a change in the number of revisions received after autologous breast reconstruction.

Meaning: Patients with a preexisting psychiatric diagnosis can be counseled that their depression or anxiety should not change how many revisions they receive.

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are the large volume of patients and the coding data associated with each patient encounter. The weaknesses lie in the reliance on accurate coding and lack of granular data that is not codable, such as social history, family history, and operative technique.

Patients were identified using Current Procedural Terminology (CPT), International Classification of Diseases, Ninth Revision (ICD-9) procedural codes, and International Classification of Diseases, Tenth Revision (ICD-10) procedural codes for free flap breast reconstruction. Only patients with a history of breast cancer, identified by ICD-9 and ICD-10 codes, and with a minimum of 3 years of follow-up were included in this study.

After creating the primary study population, patients were divided into two groups based on psychiatric history—those with a history of depression and/or GAD and those without such a history. Patients without a psychiatric history were considered the control group. Psychiatric history was determined by ICD-9 and ICD-10 diagnosis codes for both psychiatric disorders in the patient record before reconstruction. Revision procedures were followed 3 years after initial reconstruction. All codes are summarized in Table 1.

Primary Outcome and Logistic Regression

The primary outcome of this study was the average number of breast revision procedures in the 3-year period after reconstruction. Patients who did not undergo revision were excluded from the calculation. Unpaired *t* test was used to compare the average number of revisions between patients with and without a psychiatric history. A subgroup analysis of the primary outcome compared patients with GAD only, depression only, and concurrent GAD and depression. The average number of revisions between these three groups was compared with the control with analysis of variance (ANOVA) test. The secondary outcome was total rate of revision. Total revision rate was calculated within each study group by determining the percentage of patients receiving at least one revision, and the Fisher exact test was used to evaluate for statistically significant differences.

Univariate summary statistics were gathered for each group with the Fisher exact test used for categorical data and unpaired *t* test used for continuous data. Multiple logistic regression assuming binomial distribution was

Table 1. ICD and CPT Codes for breast Cancer, Autologous Breast Reconstruction, Depression, Generalized Anxiety Disorder, and Breast Revision Surgery

Diagnosis	ICD-9, ICD-10, CPT codes
Breast cancer	ICD-9-D-1740, ICD-9-D-1741, ICD-9-D-1742, ICD-9-D-1743, ICD-9-D-1744, ICD-9-D-1745, ICD-9-D-1746, ICD-9-D-1748, ICD-9-D-1749, ICD-10-D-C50011, ICD-10-D-C50012, ICD-10-D-C50019, ICD-10-D-C50111, ICD-10-D-C50112, ICD-10-D-C50119, ICD-10-D-C50211, ICD-10-D-C50212, ICD-10-D-C50219, ICD-10-D-C50311, ICD-10-D-C50312, ICD-10-D-C50319, ICD-10-D-C50411, ICD-10-D-C50412, ICD-10-D-C50419, ICD-10-D-C50511, ICD-10-D-C50512, ICD-10-D-C50519, ICD-10-D-C50611, ICD-10-D-C50612, ICD-10-D-C50619, ICD-10-D-C50811, ICD-10-D-C50812, ICD-10-D-C50819, ICD-10-D-C50911, ICD-10-D-C50912, ICD-10-D-C50919, ICD-10-D-D0500, ICD-10-D-D0501, ICD-10-D-D0502, ICD-10-D-D0510, ICD-10-D-D0511, ICD-10-D-D0512, ICD-10-D-D0580, ICD-10-D-D0581, ICD-10-D-D0582, ICD-10-D-D0590, ICD-10-D-D0591, ICD-10-D-D0592, ICD-10-D-D4860, ICD-10-D-D4861, ICD-10-D-D4862, ICD-10-D-D493
Autologous breast reconstruction	CPT-19364, CPT-19361, CPT-19366, CPT-19367, CPT-19368, CPT-19369, ICD-9-P-8570, ICD-9-P-8571, ICD-9-P-8572, ICD-9-P-8573, ICD-9-P-8574, ICD-9-P-8575, ICD-9-P-8576, ICD-10-P-0HRT075, ICD-10-P-0HRT076, ICD-10-P-0HRT077, ICD-10-P-0HRT078, ICD-10-P-0HRU075, ICD-10-P-0HRU076, ICD-10-P-0HRU077, ICD-10-P-0HRU078, ICD-10-P-0HRU079, ICD-10-P-0HRV075, ICD-10-P-0HRV076, ICD-10-P-0HRV077, ICD-10-P-0HRV078, ICD-10-P-0HRV079
Depression	ICD-9-D-29620, ICD-9-D-29621, ICD-9-D-29622, ICD-9-D-29623, ICD-9-D-29624, ICD-9-D-29625, ICD-9-D-29626, ICD-9-D-29630, ICD-9-D-29631, ICD-9-D-29632, ICD-9-D-29633, ICD-9-D-29634, ICD-9-D-29635, ICD-9-D-29636, ICD-10-D-F322, ICD-10-D-F323, ICD-10-D-F324, ICD-10-D-F325, ICD-10-D-F329, ICD-10-D-F330, ICD-10-D-F331, ICD-10-D-F332, ICD-10-D-F333, ICD-10-D-F3340, ICD-10-D-F3341, ICD-10-D-F3342, ICD-10-D-F339, ICD-10-D-F320, ICD-10-D-F321
Generalized anxiety disorder	ICD-9-D-30002, ICD-10-D-F411
Breast revision surgery	CPT-19380, CPT-20926, ICD-9-P-8555

performed to determine the association between various comorbidities, including history of psychiatric illness, and receipt of at least one revision surgery. Odds ratios were reported with 95% confidence intervals. All analyses were conducted through RStudio statistical packages integrated into the PearlDiver platform and Microsoft Excel (Microsoft Corporation, Redmond, Wash.).

RESULTS

A total of 39,683 patients had a history of breast cancer and underwent autologous breast reconstruction. Among these, 6308 (15.90%) patients had a documented history of GAD and/or depression before reconstructive surgery, and 33,375 (84.10%) patients did not have a documented mental health history.

Univariate analysis demonstrated different rates of comorbidities between both patient groups. The average age of patients with psychiatric comorbidities was 53.4 years compared with 53.8 years ($P = 0.005$) Patients with mental health disorders had higher rates of diabetes (26.7% versus 18.4%; $P < 0.00001$), high rates of obesity (37.5% versus 19.6%; $P < 0.00001$), and higher rates of tobacco use (37.1% versus 18.8%; $P < 0.00001$). Patients with a mental health disorder were exposed to higher rates of neoadjuvant chemotherapy (8.02% versus 6.00%; $P < 0.00001$), neoadjuvant radiation (2.36% versus 1.88%; $P = 0.0151$), and adjuvant radiation (10.3% versus 9.0%; $P = 0.001$). Patients without a mental health history did undergo immediate reconstruction at a higher rate (13.7% versus 10.6%; $P < 0.00001$) (Table 2). Subgroup analysis elicited 773 patients with isolated GAD history, 3630 patients with an isolated depression history, and 1494 patients with concomitant GAD and depression.

The total rate of patients receiving at least one revision was 33.8% (n = 13,422). The revision rate of patients with a history of mental health disorder was significantly lower in comparison to the control group (32.8% versus 35.1%; $P < 0.05$). Patients with a history of GAD have a similar rate of revision compared with control (32.8% versus 35.1%; $P = 0.204$). Patients with history of depression had a revision rate of 30.9% versus 35.1%, $P = 0.703$. Patients with history of both GAD and depression did not have significantly different revision rates compared with the control group (35.0% versus 35.1%; $P = 0.823$) (Table 3).

The average number of revisions reported excludes all patients who did not receive at least one revision. The average number of revisions for the 13,422 patients who underwent autologous breast reconstruction was 1.41 revisions in the 3-year postreconstruction period. Patients with a history of mental health disorders receive 1.41 revisions on average, while their counterparts receive 1.42 revisions on average ($P = 0.703$). In subset analysis, patients with depression only, GAD only, and concomitant GAD and depression received on average 1.40, 1.40, and 1.40 revisions, respectively. One-way ANOVA demonstrated no significant differences between the controls and the groups from subset analysis ($P = 0.956$) (Fig. 1).

Logistic regression was performed to determine preoperative characteristics associated with receipt of any revision after autologous breast reconstruction. History of mental health disorder was weakly protective against revision surgery (OR, 0.938; 95% CI, 0.885–0.993). Immediate reconstruction was strongly associated with receipt of revision surgery (OR, 1.61; 95% CI, 1.52–1.72). Tobacco use (OR, 1.09; 95% CI, 1.04–1.14) and obesity (OR, 1.10; 95% CI, 1.05–1.15) were weakly associated with revision surgery. Neither neoadjuvant chemotherapy nor radiation therapy was associated with receipt of revision surgery. Adjuvant chemotherapy was weakly associated with revision surgery (OR, 1.09; 95% CI, 1.01–1.18). These results are summarized in Table 4.

DISCUSSION

There is a high rate of mental illness in the plastic surgery patient population, leading to increased

Table 2. Clinical Characteristics of Patients Who Underwent Autologous Reconstruction Subdivided by Comorbid Psychiatric History and No Psychiatric History

Diagnosis	Comorbid Psychiatric History (Total = 6308)	No Psychiatric History (Total = 33,375)	P
Age	53.4	53.8	0.005
Diabetes mellitus	26.7% (1681)	18.4% (6134)	<0.0001
Obesity	37.5% (2367)	19.6% (6535)	<0.0001
Tobacco use	37.1% (2338)	18.8% (6280)	<0.0001
Immediate reconstruction	10.6% (671)	13.7% (4565)	<0.0001
Chemotherapy			
Neoadjuvant	8.0% (506)	6.0% (2004)	<0.0001
Adjuvant	9.6% (605)	10.1% (3363)	0.243
Radiation therapy			
Neoadjuvant	2.4% (149)	1.9% (629)	0.015
Adjuvant	10.3% (649)	9.0% (3000)	0.001
Psychiatric comorbidities			
Depression	57.5% (3630)		
Generalized anxiety disorder	12.3% (773)		
Depression and GAD	23.7% (1494)		

Table 3. Revision Rate and Average Revisions Subdivided into No Psychiatric History, Comorbid Psychiatric History, History Depression, and History of Generalized Anxiety Disorder

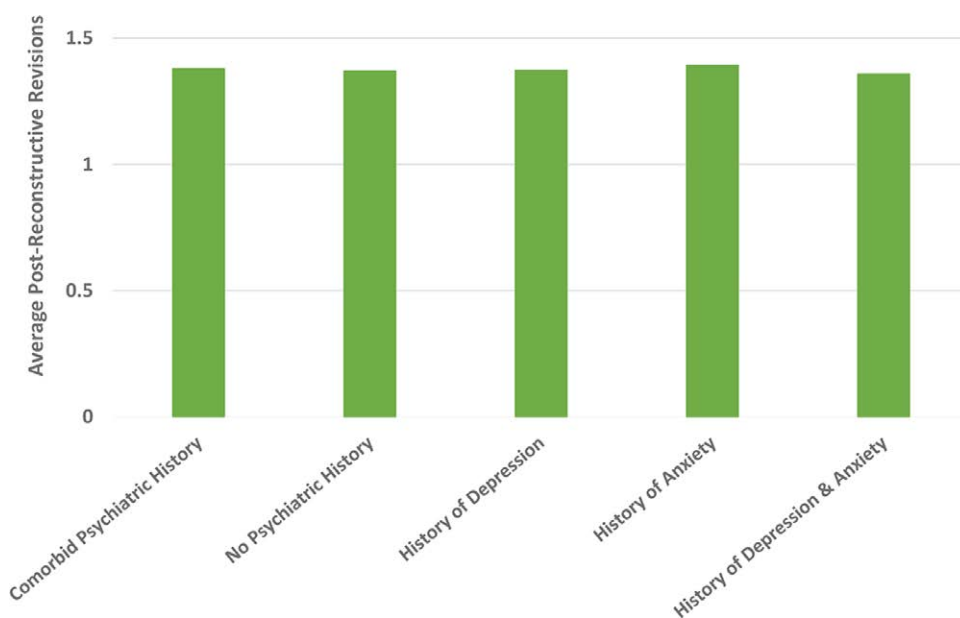| Diagnosis	No. Patients	Revision Rate (%)	P	Average Revision	P
No psychiatric history	33,375	35.1		1.42	
Comorbid psychiatric history	6308	32.8	0.0003	1.41	0.703
History of depression	2271	34.9	0.824	1.39	0.771
History of GAD	2267	33.8	0.204	1.40	0.771

Fig. 1. Average postreconstructive revisions for people with comorbid psychiatric history, no psychiatric history, history of depression, history of anxiety, and history of depression and anxiety.

complications, emotional distress, and poorer outcomes.[13–15] As is the case for most malignancies, a cancer diagnosis increases stress in a patient's life; patients with a diagnosis of breast cancer have a high rate of comorbid mental health disorders and psychological distress,[16] as well as the development of mental illness. In a meta-analysis of eight observational studies of patients with cancer (N = 1448), 32% were found to have at least one psychiatric disorder (adjustment, anxiety, depressive, somatic symptom, substance use disorder, or posttraumatic stress disorder).[17]

In this study, we analyzed a dataset that included a total of 39,683 patients diagnosed with breast cancer and who underwent autologous breast reconstruction. Previous studies consisted of a smaller sample size when addressing this question and did not use a large comprehensive database; while the PearlDiver database offered a large database of HIPAA-compliant patient records to assess our study question and better analyze the impact of mental health on revision surgery. Our analysis showed that patients with a presurgical diagnosis of GAD and/or depression did not receive significantly

Table 4. Multivariate Logistic Regression Examining Preoperative Characteristics Associated with Receipt of Any Revision after Autologous Breast Reconstruction

Logistic Regression	Odds Ratio	95% CI	*P*
Age	0.975	0.973–0.977	<0.0001
Charleston comorbidity index	1.03	1.02–1.03	<0.0001
Psychiatric history	0.938	0.885–0.993	0.029
Diabetes	0.912	0.868–0.958	<0.0001
Obesity	1.10	1.05–1.15	<0.0001
Tobacco use	1.09	1.04–1.14	<0.001
Immediate reconstruction	1.61	1.52–1.72	<0.0001
Neoadjuvant chemotherapy	0.956	0.868–1.05	0.357
Adjuvant chemotherapy	1.09	1.01–1.18	0.031
Neoadjuvant radiation	1.09	0.937–1.27	0.257
Adjuvant radiation	1.07	0.979–1.16	0.137

more revisions than their comorbid-free counterparts (1.40 versus 1.42). When depression and anxiety were each examined in isolation, no significant differences were found between these groups and patients with no psychiatric history. On the contrary, previous literature has shown that psychiatric disorders can affect postoperative outcomes in reconstructive plastic surgery patients. In a MarketScan database study conducted from 2007 to 2015 comparing patients with and without psychiatric diagnoses undergoing reconstructive plastic surgery (N = 505,715), the authors found that patients with psychiatric disorders had a 5.53% rate of complication (ie, surgical site infections, wound-healing complications, bleeding/hematoma, and hospital admission) versus 2.03% in nonpsychiatric patients (OR, 2.00; 95% CI, 1.28–3.11).[18] In addition, in 2019, Orr et al[5] found that preoperative anxiety (OR, 4.34; 95% CI, 1.31–14.38; *P* = 0.016) was a significant predictor for receiving a revision operation after undergoing autologous breast reconstruction. These findings demonstrate that mental health impacts the overall postoperative course for reconstructive plastic surgery patients.

Reconstructive breast surgery, as a procedure that is post oncological diagnosis, can have varying effects on mental health outcomes and thus have varying outcomes on self-perceptions and overall satisfaction. Interestingly, in 2018, Chen et al found that breast reconstruction decreased anxiety (RR, 0.62; 95% CI, 0.47–0.82; *P* = 0.0006) and depression (RR, 0.54; 95% CI, 0.32–0.93; *P* = 0.02) postoperatively compared with mastectomy alone. Our study demonstrated that patients undergoing autologous breast reconstruction with a psychiatric comorbidity had a similar rate of revisions as those without a psychiatric comorbidity.

Potentially negative postoperative outcomes for breast cancer have led to increased awareness of using screening tools and questionnaires to assess for psychiatric illness in patients undergoing breast reconstruction. The BREAST-Q is a validated questionnaire that evaluates patient satisfaction and health-related quality of life after surgery. It is used to assess patient's perceived outcome following surgery. One study found that patients (N = 471) with a psychiatric diagnosis were significantly less likely to receive autologous reconstruction compared with those without one (OR, 0.556; *P* = 0.014).[19] Yet, patients who underwent autologous tissue reconstruction had more

satisfaction with their reconstructed breast outcomes compared with those who did not.[20,21] These results suggest that psychiatric diagnosis had an overall positive effect on patient satisfaction after breast reconstruction supporting our finding that psychiatric diagnoses do not necessarily lead to increased revision rates. Our study also showed that immediate reconstruction was predictive of revision surgery, but that psychiatric illness was a protective factor. Although no studies have demonstrated immediate reconstruction is associated with increased revisions, we hypothesize that patients who have immediate breast reconstruction will have less control of the initial reconstructive outcome in comparison to a delayed reconstruction regarding size and symmetry. Therefore, these patients will seek out more revisions to accomplish their aesthetic goals. Our findings show that although autologous breast reconstruction revisions are a more surgically arduous process, psychiatric illness does not affect the revision rate and possibly leads to improved patient satisfaction. In fact, our results demonstrate that patients with psychiatric comorbidities should not be deterred from undergoing autologous breast reconstruction out of concern for higher revision rates.

This study had several limitations inherent to database studies. Our data did not examine patients who might have been diagnosed with a psychiatric condition after their surgery. Future studies should involve looking at timing of diagnosis and average number of revisions, considering this limitation. Additionally, overall patient satisfaction was not addressed in this study. It would be important to examine the difference between overall satisfaction between patients undergoing autologous breast reconstruction with a psychiatric history and without a psychiatric history. Also, we could not evaluate the decision-making process between providers and patients given the limitations of the dataset. The PearlDiver database also relies on accurate procedural and diagnosis coding, and our conclusions were made based on coding accuracy; thus, uncontrollable coding mistakes are a source of error in this dataset. Given the nature of a database study, we could have also missed some revisions in the analysis if the surgery was coded differently as CPT codes are broad for breast revisions. Our study found that there was an overall 33.8% revision rate in patients who underwent autologous breast reconstruction, which could be lower than expected since our study was limited to the codes used

in the analysis. There is also no way to evaluate long-term outcomes with this database and no ability to determine the reason for revision.

Multiple factors go into breast reconstruction and mental health disorders alone do not seem to affect the rate of revision in a post-mastectomy patient undergoing breast reconstruction. A preoperative psychiatric assessment for patients undergoing breast reconstruction after mastectomy can be considered in the preoperative discussion with patients; however, our study shows that unlike in aesthetic breast surgery, surgeons and patients should not expect mental health to contribute to an increased number of revisions. Given our study's large patient population (n = 39,683) from various healthcare centers, we suggest that these results may be replicable throughout the United States of America. We recognize that there is little information surrounding breast reconstruction revision rates in patients with anxiety or depression without concomitant cancer diagnoses, hence the importance of doing an analysis on the effects of mental illness on revision rates in general.

CONCLUSIONS

Our findings show that current or previous psychiatric history of anxiety and/or depression has no overall effect on the number of revisions for patients undergoing autologous breast reconstruction. Although providers should screen for psychiatric comorbidities, it is unnecessary to provide additional or alternative preoperative counseling compared with patients without mental health disorders. Generally, patients with psychiatric disorders can be assured that their postoperative course is unlikely to differ significantly from the average breast reconstruction patient. However, after undergoing autologous breast reconstruction, it is important to utilize clinical tools such as the BREAST-Q, which evaluates patients' experiences with reconstructive breast surgery, to assess overall quality of life and help in the decision-making process of subsequent revision procedures.[22] While mental health issues factor less into the number of revisions, it is still important to evaluate overall quality of life and patient satisfaction after breast reconstruction.

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