Complications Following Reduction Mammaplasty: A Review of 3538 Cases From the 2005-2010 NSQIP Data Sets

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John P. Fischer, MD; Emily C. Cleveland, BA; Eric K. Shang, MD; Jonas A. Nelson, MD; and Joseph M. Serletti, MD

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Abstract

Background: Reduction mammaplasty is an established and effective technique to treat symptomatic macromastia. Variable rates of complications have been reported, and there is a continued need for better outcome assessment studies.

Objective: The authors investigate predictors of postoperative complications following reduction mammaplasty using the National Surgery Quality Improvement Program (NSQIP) data sets.

Methods: The 2005-2010 American College of Surgeons NSQIP databases were reviewed to identify primary encounters for reduction mammaplasty using *Current Procedural Terminology* code 19318. Two complication types were recorded: major complications (deep infection and return to operating room) and any complication (all surgical complications). Preoperative patient factors and comorbidities, as well as intraoperative variables, were assessed. A multivariate regression analysis was used to identify independent predictors of complications.

Results: A total of 3538 patients were identified with an average age of 43 years and body mass index of 31.6 kg/m^2. Most patients underwent outpatient surgery (80.5%) with an average operative time of 180 minutes. The incidence of overall surgical complications was 5.1%. The following factors were independently associated with any surgical complications: morbid obesity (odds ratio [OR], 2.1; $P < .001$), active smoking (OR, 1.7; $P < .001$), history of dyspnea (OR, 2.0; $P < .001$), and resident participation (OR, 1.8; $P = .01$). The incidence of major surgical complications was 2.1%. Factors associated with major complications included active smoking (OR, 2.7; $P < .001$), dyspnea (OR, 2.6; $P < .001$), resident participation (OR, 2.1; $P < .001$), and inpatient surgery (OR, 1.8; $P = .01$).

Conclusions: This study demonstrates overall incidence of complications in 1 in 20 patients and a 1 in 50 incidence of a major surgical complication. Noteworthy findings include the identification of morbid obesity as a significant predictor of overall morbidity and active smoking as a strong predictor of major surgical morbidity. These data can assist surgeons in preoperative counseling and enhance perioperative decision making.

Level of Evidence: 3

Keywords

breast reduction, outcomes, NSQIP, complications

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Reduction mammaplasty is one of the most common surgical procedures performed by plastic surgeons in the United States.[1] Symptomatic breast hypertrophy can cause significant musculoskeletal pathology as well as chronic dermatologic conditions, including intertriginous rash along the inframammary fold, leading to decreased quality of life.[2-5] Reduction mammaplasty has been shown to significantly improve symptoms and quality of life.[6,7] These symptomatic improvements are complemented by high and durable rates

From the Division of Plastic Surgery, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania.

Corresponding Author:
Dr Joseph M. Serletti, Henry Royster-William Maul Measey Professor of Plastic and Reconstructive Surgery, Division of Plastic Surgery, University of Pennsylvania, 3400 Spruce St, Philadelphia, PA 19104, USA.
E-mail: joseph.serletti@uphs.upenn.edu

of patient satisfaction following the procedure.[8] However, in an era of ever increasing cost-awareness, reduction mammaplasty has also been demonstrated to be a cost-effective means for reducing patient morbidity[9] and has also been suggested as a useful tool for cancer screening in women with macromastia.[10,11]

A variety of techniques for reducing breast volume have been developed since reduction mammaplasty was first introduced in the late 19th century.[12] Complication rates may vary according to the techniques employed for reduction mammaplasty. These commonly include the inferior pedicle[13] and vertical mammaplasty,[14] as well as other modifications.[15,16]

Nevertheless, the benefits of reduction mammaplasty must be weighed against the potential costs of complications. Recent studies have shown that patient age,[17] weight,[18-21] and smoking status[22-25] may have an adverse impact on their overall outcomes. Furthermore, intraoperative considerations, including the weight of breast tissue resected[2,19,25] and the participation of resident surgical trainees,[24,26,27] may affect subsequent patient complications.

Most studies to date have examined relatively small cohorts of women undergoing reduction mammaplasty, often at a single institution by a single or small number of surgeons. We therefore sought to characterize predictors of postoperative complications following reduction mammaplasty based on data from the American College of Surgeons–National Surgical Quality Improvement Program (ACS-NSQIP) data sets.

METHODS

We identified patients undergoing reduction mammaplasty in the 2005-2010 NSQIP data sets.[28] Deidentified patient information is freely available to all institutional members who comply with the ACS-NSQIP Data Use Agreement. The Data Use Agreement implements the protections afforded by the Health Insurance Portability and Accountability Act (HIPAA) of 1996. 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 of this study. Institutional review board exemption was approved by our institution.

Trained research nurses at participating institutions collect NSQIP data using a systematic sampling of general and vascular surgical procedures. A total of 240 variables are collected for each case encounter, including information on patient demographics, comorbidities, intraoperative factors, and postoperative 30-day morbidity and mortality. To ensure a full 30-day postoperative follow-up period for each encounter, patients are contacted either via a letter or a telephone call. Definitions and further information about each of these variables can be accessed via the ACS-NSQIP website (http://site.acsnsqip.org/). Prior audits have demonstrated a relatively low (1.8%) disagreement rate for program variables. The use of the ACS-NSQIP datasets and its associated variables in plastic surgery has been previously published.[29-33]

We accessed data on October 1, 2012. Patients included in our study were identified using the 2010 *Current Procedural Terminology* (*CPT*) code for reduction mammaplasty (19318). We combined several of the predefined NSQIP variables to characterize our 2 major end points: any surgical complication and major surgical complications. Surgical complications included surgical site infection, wound dehiscence, deep wound infection, and unplanned return to the operating room within 30 days. Major surgical complications were defined as a deep infection and/or unplanned return to the operating room. In addition to the aforementioned variables, we separately characterized patients as obese (body mass index [BMI] ≥30 kg/m^2) or nonobese (BMI <30 kg/m^2) using the World Health Organization definition of obesity.[28,34] Obese patients were further categorized as class 1 (BMI = 30-34.9 kg/m^2), class 2 (BMI = 35-39.9 kg/m^2), or class 3 (BMI ≥40 kg/m^2).

Univariate analysis was used to compare patients experiencing complications with those who did not. Patient comorbidities and perioperative risk factors were identified among NSQIP variables, including baseline health characteristics, preoperative laboratory studies, and intraoperative factors, including operative time and the participation of surgical residents. Categorical variables were analyzed using the Pearson χ^2 or Fisher exact test, while continuous variables were examined using the unpaired Student t test or Mann-Whitney tests. After univariate analysis, any variables with a $P \leq .10$ were included as independent variables in a stepwise logistic regression analysis, with either any surgical complication or major surgical complications as the dependent variables. All tests were 2-tailed; we defined statistical significance as $P < .05$. All analyses were performed using STATA IC 11.0 (StataCorp, College Station, Texas).

RESULTS

General

A total of 3538 patients were identified as having undergone reduction mammaplasty during the study period. The demographics of these patients are summarized in Table 1. Patient comorbidities are summarized in Table 2. Collectively, the cohort had an average BMI of 31.6 kg/m^2, with 49.8% of the cohort meeting criteria for obesity. Of these, 29% were class 1, 16.2% class 2, and 10% were class 3 according to World Health Organization (WHO) criteria.[35] Of note, a significant proportion of patients (12.1%) were active smokers. Most patients underwent outpatient surgery (80.5%) with an average operative time of 180 minutes. Most reductions were performed by plastic surgeons (3095, 87.5%) while the remainder were done by general surgeons. Surgical residents participated in 1422 of the cases (40.2%) included in this study.

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Table 1. Summary Demographic Characteristics of Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	Value
Race	
White	2173 (61.4)
African American	681 (19.3)
Asian	16 (0.5)
Indian	19 (0.5)
Pacific Islander	36 (1.0)
Unknown	612 (17.3)
Age, mean (SD), y	43.2 (14.1)
Operation year	
2010	1664 (47.0)
2009	835 (23.6)
2008	658 (18.6)
2007	281 (7.9)
2006	91 (2.6)
2005	8 (0.2)
Inpatient	691 (19.5)
Outpatient	2846 (80.5)
Resident involvement	
No resident	2115 (59.8)
Resident	1422 (40.2)

Values are presented as number (%) unless otherwise indicated. NSQIP, National Surgery Quality Improvement Program.

Surgical Complications

A total of 182 patients (5.1%) experienced surgical complications within 30 days of reduction mammaplasty. The incidence of major complications was 2.1% in the study cohort. The incidence of other medical and surgical complications is summarized in Table 3.

Patients experiencing surgical complications had a higher average BMI (33.4 vs 31.5 kg/m^2, P = .001), with a significantly larger proportion of morbidly obese patients (BMI ≥40 kg/m^2, 18.7% vs 9.6%, P < .001; Tables 4 and 5). Patients experiencing complications had higher rates of diabetes (P = .04), smoking (P = .01), chronic obstructive pulmonary disease (COPD; P = .05), hypertension (P = .05), and dyspnea (P = .001) (Table 5). This cohort also had significantly higher American Society of Anesthesiologists

Table 2. Summary of Comorbidities of Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	Value
Body mass index, mean (SD), kg/m^2	31.6 (6.6)
WHO obesity classification	
Class 1	1024 (29.0)
Class 2	573 (16.2)
Class 3	355 (10.0)
Diabetes	164 (4.6)
Active smoking	427 (12.1)
Use of alcohol	20 (0.6)
Dyspnea	
None	3434 (97.1)
Moderate	102 (2.9)
Functional status	
Independent	3523 (99.6)
Partial	12 (0.3)
History of chronic obstructive pulmonary disease	28 (0.8)
Prior percutaneous cardiac intervention	24 (0.7)
Prior cardiac surgery	13 (0.4)
Angina	5 (0.1)
Hypertension	850 (24.0)
History of peripheral vascular disease	5 (0.1)
History of transient ischemic attack	20 (0.6)
Open wound or active infection	12 (0.3)
Current use of steroids	31 (0.9)
Recent weight loss	4 (0.1)
Bleeding disorder	18 (0.5)
Hypoalbuminemia	36 (1.0)
Wound class	
Clean	3481 (98.4)
Clean-contaminated	51 (1.4)
Contaminated	4 (0.1)
Infected	1 (0.0)
ASA classification	
1	752 (21.3)
2	2322 (65.6)
3	451 (12.8)
4	8 (0.2)
Operative time, mean (SD), min	180.7 (71.8)
Length of stay, mean (SD), d	0.8 (4.5)

Values are presented as number (%) unless otherwise indicated. ASA, American Society of Anesthesiologists; NSQIP, National Surgery Quality Improvement Program; WHO, World Health Organization.

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Table 3. Summary of Complications of Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	No. (%)
Major surgical complication	75 (2.1)
Medical complication	24 (0.7)
Any surgical complication	182 (5.1)
Superficial infection	97 (2.7)
Deep infection	7 (0.2)
Organ space infection	3 (0.1)
Wound dehiscence	28 (0.8)
Pulmonary embolism	2 (0.1)
Deep venous thrombosis	1 (0.0)
Unplanned reintubation	1 (0.0)
Renal failure	2 (0.1)
Urinary tract infection	5 (0.1)
Blood transfusion	12 (0.3)
Sepsis	3 (0.1)
Return to operative room	68 (1.9)

NSQIP, National Surgery Quality Improvement Program.

Table 4. Patient Demographics Associated With Surgical Complications in Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	None (n = 3355)	Complication (n = 182)	*P Value*
Race			
White	2055 (61.3)	118 (64.8)	.42
African American	644 (19.2)	37 (20.3)	
Asian	16 (0.5)	0	
Indian	19 (0.6)	0	
Pacific Islander	36 (1.1)	0	
Unknown	585 (17.4)	27 (14.8)	
Age, mean (SD), y	43.2 (14.1)	43.2 (13.7)	.94
Operation year			
2010	1583 (47.2)	81 (44.5)	.76
2009	785 (23.4)	50 (27.5)	
2008	623 (18.6)	35 (19.2)	
2007	270 (8.0)	11 (6.0)	
2006	86 (2.6)	5 (2.7)	
2005	8 (0.2)	0	
Inpatient	649 (19.3)	42 (23.1)	.22
Outpatient	2706 (80.7)	140 (76.9)	
Resident involvement			
No resident	2029 (60.5)	86 (47.3)	<.001
Resident	1326 (39.5)	96 (52.7)	

Values are presented as number (%) unless otherwise indicated. NSQIP, National Surgery Quality Improvement Program.

(ASA) physical status ($P < .001$) and slightly longer lengths of hospital stay (0.9 vs 0.8 days, $P = .02$). Patients experiencing complications were more likely to have had a resident involved in their operation (52.7 vs 39.5%, $P < .001$; Table 4).

In addition, we specifically assessed the subgroup of patients experiencing major surgical complications (Tables 6 and 7). These patients trended toward having a higher average BMI (32.9 vs 31.6 kg/m^2, $P = .08$). Patients with major complications were, however, more likely to be active smokers ($P = .001$) and more often had a history of dyspnea ($P = .03$) and transient ischemic attacks ($P = .03$). These patients again had higher ASA scores ($P < .001$), longer lengths of stay ($P = .04$), and longer average operative times (194 vs 180 minutes, $P = .04$) than patients who did not experience major complications.

Logistic Regression Analysis

A number of risk factors were found to be independently associated with surgical complications: morbid obesity (odds ratio [OR], 2.1; $P < .001$), active smoking (OR, 1.7; $P < .001$), history of dyspnea (OR, 2.0; $P < .001$), and resident participation (OR, 1.8; $P = .01$). Notable factors that were not significantly associated with surgical complications include inpatient status, diabetes mellitus, alcohol use, COPD, and any cardiovascular risk factors. Factors independently associated with major complications included tobacco use (OR, 2.7; $P < .001$), dyspnea (OR, 2.6; $P < .001$), resident participation (OR, 2.1; $P < .001$), and inpatient surgery (OR, 1.8; $P = .01$).

DISCUSSION

This study examines 30-day complications following reduction mammaplasty in a large cohort of patients identified in the ACS-NSQIP database. The overall rate of surgical complications was relatively low, with 5.1% of patients experiencing a surgical site infection, wound dehiscence, deep wound infection, and/or unplanned return to the

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Table 5. Patient Comorbidities Associated With Surgical Complications in Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	None (n = 3355)	Complication (n = 182)	*P* Value
Body mass index, mean (SD), kg/m^2	31.5 (6.6)	33.4 (7.4)	.001
WHO obesity classification			
Class 1	974 (29.0)	50 (27.5)	.65
Class 2	542 (16.2)	31 (17.0)	.76
Class 3	321 (9.6)	34 (18.7)	<.001
Diabetes	150 (4.5)	14 (7.7)	.04
Active smoking	394 (11.7)	33 (18.1)	.01
Use of alcohol	20 (0.6)	0	.62
Dyspnea			
None	3265 (97.3)	169 (92.9)	.001
Moderate	89 (2.7)	13 (7.1)	
Functional status			
Independent	3343 (99.6)	180 (98.9)	.12
Partial	10 (0.3)	2 (1.1)	
History of chronic obstructive pulmonary disease	24 (0.7)	4 (2.2)	.05
Prior percutaneous cardiac intervention	23 (0.7)	1 (0.5)	1.00
Prior cardiac surgery	12 (0.4)	1 (0.5)	.50
Angina	4 (0.1)	1 (0.5)	.23
Hypertension	795 (23.7)	55 (30.2)	.05
History of peripheral vascular disease	4 (0.1)	1 (0.5)	.23
History of transient ischemic attack	17 (0.5)	3 (1.6)	.08
Open wound or active infection	10 (0.3)	2 (1.1)	.12
Current use of steroids	28 (0.8)	3 (1.6)	.25
Recent weight loss	4 (0.1)	0	1.00
Bleeding disorder	16 (0.5)	2 (1.1)	.24
Hypoalbuminemia	34 (1.0)	2 (1.1)	.36
Wound class			
Clean	3305 (98.5)	176 (96.7)	.001
Clean-contaminated	48 (1.4)	3 (1.6)	
Contaminated	2 (0.1)	2 (1.1)	
Infected	0	1 (0.5)	
ASA classification			
1	728 (21.7)	24 (13.2)	<.001
2	2211 (65.9)	111 (61.0)	
3	404 (12.0)	47 (25.8)	
4	8 (0.2)	0	
Operative time, mean (SD), min	180.4 (72.0)	187.1 (67.8)	.23
Length of stay, mean (SD), d	0.8 (4.7)	0.9 (1.3)	.02

Values are presented as number (%) unless otherwise indicated. ASA, American Society of Anesthesiologists; NSQIP, National Surgery Quality Improvement Program; WHO, World Health Organization.

Table 6. Patient Demographics Associated With Major Surgical Complications in Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	None (n = 3462)	Complication (n = 75)	*P* Value
Race			
White	2121 (61.3)	62 (82.7)	.15
African American	663 (19.2)	18 (24.0)	
Asian	19 (0.5)	0	
Indian	36 (1.0)	0	
Pacific Islander	16 (0.5)	0	
Unknown	607 (17.5)	5 (6.7)	
Age, mean (SD), y	43.2 (14.1)	44.2 (12.4)	.54
Operation year			
2010	1633 (47.2)	31 (41.3)	.92
2009	814 (23.5)	21 (28.0)	
2008	643 (18.6)	15 (20.0)	
2007	275 (7.9)	6 (8.0)	
2006	89 (2.6)	2 (2.7)	
2005	8 (0.2)	0	
Inpatient	665 (19.2)	26 (34.7)	.001
Outpatient	2797 (80.8)	49 (65.3)	
Resident involvement			
No resident	2085 (60.2)	30 (40.0)	<.001
Resident	1377 (39.8)	45 (60.0)	

Values are presented as number (%) unless otherwise indicated. NSQIP, National Surgery Quality Improvement Program.

operating room within 30 days. A smaller portion of the cohort, 2.1%, experienced 1 of the latter 2 major surgical complications. These rates compare favorably to those in previously published series, but it should be noted that many of these other studies include additional complications not identified in our data set.

Most previously published studies examining reduction mammaplasty have reviewed risk factors retrospectively among small cohorts of patients, generally at a single institution. These studies have brought to light a variety of potential risk factors for both major and minor complications following reduction mammaplasty, but the conclusions drawn may be affected by surgeon preferences and techniques. Our study, in contrast, reviewed more than 3500 cases performed at institutions across the country, relying on validated, prospective data. Our findings may therefore be more appropriate for generalization

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Table 7. Patient Comorbidities Associated With Major Surgical Complications in Patients Undergoing Breast Reduction During 2005-2010 Identified Within NSQIP Data Sets (N = 3537)

Characteristic	None (n = 3462)	Complication (n = 75)	*P* Value
Body mass index, mean (SD), kg/m^2	31.6 (6.6)	32.9 (6.8)	.08
WHO obesity classification			
Class I	1006 (29.1)	18 (24.0)	.32
Class II	558 (16.1)	15 (20.0)	.35
Class III	343 (9.9)	12 (16.0)	.09
Diabetes	160 (4.6)	4 (5.3)	.77
Active smoking	409 (11.8)	18 (24.0)	.001
Use of alcohol	20 (0.6)	0	.51
Dyspnea			
None	3365 (97.2)	69 (92.0)	.03
Moderate	96 (2.8)	6 (8.0)	
Functional status			
Independent	3448 (99.6)	75 (100.0)	1
Partial	12 (0.3)	0	
History of chronic obstructive pulmonary disease	28 (0.8)	0	1
Prior percutaneous cardiac intervention	23 (0.7)	1 (1.3)	.49
Prior cardiac surgery	12 (0.3)	1 (1.3)	.24
Angina	4 (0.1)	1 (1.3)	.1
Hypertension	825 (23.8)	25 (33.3)	.06
History of peripheral vascular disease	19 (0.5)	1 (1.3)	.35
History of transient ischemic attack	10 (0.3)	2 (2.7)	.03
Open wound or active infection	31 (0.9)	0	1
Current use of steroids	4 (0.1)	0	1
Recent weight loss	16 (0.5)	2 (2.7)	.06
Bleeding disorder	34 (1.0)	2 (2.7)	.09
Hypoalbuminemia	34 (1.0)	2 (2.7)	.09
Wound class			
Clean	3410 (98.5)	71 (94.7)	.001
Clean-contaminated	49 (1.4)	2 (2.7)	
Contaminated	3 (0.1)	1 (1.3)	
Infected	0	1 (1.3)	
ASA classification			
1	745 (21.5)	7 (9.3)	<.001
2	2276 (65.7)	46 (61.3)	
3	429 (12.4)	22 (29.3)	
4	8 (0.2)	0	
Operative time, mean (SD), min	180.4 (71.9)	194.3 (62.7)	.04
Length of stay, mean (SD), d	0.8 (4.6)	1.0 (1.4)	.04

Values are presented as number (%) unless otherwise indicated. ASA, American Society of Anesthesiologists; NSQIP, National Surgery Quality Improvement Program; WHO, World Health Organization.

across the population of patients seeking reduction mammaplasty.

Several key risk factors were identified in our study. Of particular interest is the identification of a history of dyspnea as an independent risk factor for both overall surgical complications and major surgical complications. Compromised preoperative respiratory function has not been previously established as a risk factor for patients undergoing reduction mammoplasty and may reflect overall health status and be associated with prior smoking histories. Tobacco use has been shown to impair wound healing in a variety of plastic surgery procedures.[24] A significant proportion of our study cohort (12.1%) were active smokers at the time of their reduction mammaplasty. Our study supports findings of other authors[22,23,25] identifying smoking as a significant risk factor for complications following this procedure (OR, 1.7; $P < .001$ for any complication and OR, 2.7; $P < .001$ for major surgical complications). Smoking has also been shown to be an established risk factor for surgical morbidity in breast reconstruction.[31-33] These findings, in conjunction with other data suggesting that smoking affects wound healing in a dose- and time-dependent manner,[22] further underscore the need to effectively counsel patients regarding smoking cessation at least 4 weeks before performing an elective operation such as reduction mammaplasty.

Nearly half the patients in our study cohort were obese at the time of surgery (49.8%). When stratified by WHO obesity classification, morbidly obese patients (BMI >40 kg/m^2) were more than twice as likely as healthy-weight patients to experience surgical complications (OR, 2.1; $P < .001$). Despite some data suggesting that BMI does not significantly affect complication rates after reduction mammaplasty,[3,25,34] our findings support previously published studies identifying BMI as a predictor of postoperative complications in breast reduction.[8-21,29,30] Interestingly, obesity did not appear to be an independent risk factor for major surgical complications (deep infection and/or unplanned return to the operating room). The increased rate of overall complications in obese patients in this study may be due to a higher incidence of wound dehiscence and other nonoperative healing problems. Obesity has been shown to have an adverse effect on myofibroblast activity and collagen maturation,[37,38] both of which are critical factors in healing the long surgical incisions involved in reduction mammaplasty. Because obese patients are at greater risk of experiencing significant complications, particular care must be taken in discussing these concerns preoperatively. Weight loss should be considered as a risk reduction measure prior to undergoing elective reduction mammaplasty.

Patients undergoing inpatient reduction mammaplasty comprised 19.5% of the study cohort. Inpatient surgery was found to be an independent predictor of major postoperative complications (OR, 1.8; $P = .01$); however, this finding may be confounded by other factors not captured in the NSQIP variables. Furthermore, the presence of inpatient status likely increases the chance that a complication is captured, thereby introducing some selection bias.

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Several studies have recently reviewed the impact of surgical resident involvement (SRI) in operative procedures. Some studies have suggested that SRI increases major and minor complications in some procedures,[26] and we also identified resident participation as a risk factor for surgical complications following breast reduction (OR, 1.8; P = .01). However, other recent studies examining ACS-NSQIP data have found that when patients are more closely matched to control for possible confounders, SRI does not appear to adversely affect major outcomes,[27] including in plastic surgery procedures.[24] Our study did not control for level of training of residents participating in cases, nor did we match patients to the same degree as these other studies. Had we controlled for these significant confounders, SRI might not have been a strong predictor of complications following breast reduction, although this finding merits further investigation.

In summary, approximately 5% of patients undergoing reduction mammaplasty experience significant complications within 30 days of surgery. The key predictors of postoperative complications in our study were primarily modifiable, patient-related risk factors (obesity, tobacco use, and dyspnea). The identification of obesity and active smoking as significant predictors of postoperative complications suggests that surgeons should carefully consider whether to perform breast reductions in this patient population. The information presented in this study will allow surgeons to better risk-stratify patients seeking reduction mammaplasty and may assist in the development of screening tools to better select appropriate candidates.

There are a number of limitations to this study. The ACS-NSQIP database collects patient information for only 30 postoperative days and thus may underestimate the true rate of complications following reduction mammaplasty. In addition, the database does not contain specific information regarding surgical techniques employed for each reduction mammaplasty. We therefore are unable to determine whether the type of pedicle used was a significant factor contributing to the rate of surgical complications; this may be of particular concern in the obese population.[4] Similarly, the weight of resected tissue was not available for analysis and thus could not be explored as a potential factor influencing complication rates. This is particularly important given that recent data have suggested that higher-weight resections increase the risk of complications,[20,25] without added benefit in terms of postoperative improvement in the patient's symptoms.[2] Only a handful of surgical complications were reviewed in this study. Necrosis of the nipple-areolar complex is one of the most troubling complications following reduction mammaplasty,[21,25] which again may be of particular concern in the obese population.[4] We were not, however, able to examine data relating to this particular complication. Similarly, most publications examining complications following breast reduction have reviewed not only rates of infection and reoperation but also more detailed complications such as hematoma,[19] seroma,[21] delayed wound healing,[22,23] and/or hypertrophic scarring.[25] Because the ACS-NSQIP databases do not contain information regarding many of these specific complications, we are not able to comment on the rates or risk factors related to these important concerns.

CONCLUSIONS

This study represents the largest review to date characterizing postoperative surgical complications following reduction mammaplasty, using prospective data from a validated, multicenter database. We report an overall incidence of complications in 1 in 20 patients and a 1 in 50 incidence of a major surgical complication. We identified several independent risk factors associated with surgical complications, including smoking, obesity, dyspnea, and resident participation. Modifiable factors associated with both surgical complications and major complications, such as obesity, smoking, and respiratory function, present new opportunities to risk-stratify, select, and manage patients seeking reduction mammaplasty.

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REFERENCES

1. American Society for Aesthetic Plastic Surgery. ASAPS National Data Bank Statistics. http://www.surgery.org/media/statistics.
2. Kalliainen LK, ASPS Health Policy Committee. ASPS clinical practice guideline summary on reduction mammaplasty. *Plast Reconstr Surg*. 2012;130:785-789.
3. Boschert MT, Barone CM, Puckett CL. Outcome analysis of reduction mammaplasty. *Plast Reconstr Surg*. 1996;98:451-454.
4. Setala L, Papp A, Joukainen S, et al. Obesity and complications in breast reduction surgery: are restrictions justified? *J Plast Reconstr Aesthetic Surg*. 2009;62:195-199.
5. Wagner DS, Alfonso DR. The influence of obesity and volume of resection on success in reduction mammaplasty: an outcomes study. *Plast Reconstr Surg*. 2005;115:1034-1038.
6. Saariniemi KM, Keranen UH, Salminen-Peltola PK, Kuokkanen HO. Reduction mammaplasty is effective treatment according to two quality of life instruments: a prospective randomised clinical trial. *J Plast Reconstr Aesthetic Surg*. 2008;61:1472-1478.
7. Blomqvist L, Eriksson A, Brandberg Y. Reduction mammaplasty provides long-term improvement in health status and quality of life. *Plast Reconstr Surg*. 2000;106:991-997.
8. Bouwer LR, van der Biezen JJ, Spronk CA, van der Lei B. Vertical scar versus the inverted-T scar reduction

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mammaplasty: a 10-year follow-up. *J Plast Reconstr Aesthetic Surg*. 2012;65:1298-1304.
9. Saariniemi KM, Kuokkanen HO, Rasanen P, Sintonen H, Tukiainen EJ. The cost utility of reduction mammaplasty at medium-term follow-up: a prospective study. *J Plast Reconstr Aesthetic Surg*. 2012;65:17-21.
10. Dini M, Agostini T, Marino G, Quercioli F. Unsuspected breast carcinoma in reduction mammaplasty specimens and the role of pathologic examination. *Plast Reconstr Surg*. 2011;128:815-816.
11. Roberts JM, Clark CJ, Campbell MJ, Paige KT. Incidence of abnormal mammograms after reduction mammoplasty: implications for oncoplastic closure. *Am J Surg*. 2011;201:611-614.
12. Gargano F, Tessier P, Wolfe SA. Breast reduction with dermoglandular flaps: Tessier's "total dermo-mastopexy" and the "yin-yang technique." *Ann Plast Surg*. 2011;67:S42-S54.
13. Mandrekas AD, Zambacos GJ, Anastasopoulos A, Hapsas DA. Reduction mammaplasty with the inferior pedicle technique: early and late complications in 371 patients. *Br J Plast Surg*. 1996;49:442-446.
14. Lejour M. Vertical mammaplasty: early complications after 250 personal consecutive cases. *Plast Reconstr Surg*. 1999;104:764-770.
15. Guo K, Sun J, Qiao Q, Guo N, Guo L. Safety, efficacy, and modifications of the dermal bra technique for reduction mammaplasty and ptosis correction: a 10-year retrospective study. *Plast Reconstr Surg*. 2012;129:1237-1245.
16. Pascone M, Di Candia M, Pascone C. The three dermoglandular flap support in reduction mammaplasty. *Plast Reconstr Surg*. 2012;130:1e-10e.
17. Shermak MA, Chang D, Buretta K, Mithani S, Mallalieu J, Manahan M. Increasing age impairs outcomes in breast reduction surgery. *Plast Reconstr Surg*. 2011;128:1182-1187.
18. Zubowski R, Zins JE, Foray-Kaplon A, et al. Relationship of obesity and specimen weight to complications in reduction mammaplasty. *Plast Reconstr Surg*. 2000;106:998-1003.
19. Chun YS, Schwartz MA, Gu X, Lipsitz SR, Carty MJ. Body mass index as a predictor of postoperative complications in reduction mammaplasty. *Plast Reconstr Surg*. 2012;129:228e-233e.
20. O'Grady KF, Thoma A, Dal Cin A. A comparison of complication rates in large and small inferior pedicle reduction mammaplasty. *Plast Reconstr Surg*. 2005;115:736-742.
21. Gulcelik MA, Dogan L, Camlibel M, et al. Early complications of a reduction mammoplasty technique in the treatment of macromastia with or without breast cancer. *Clinical Breast Cancer*. 2011;11:395-399.
22. Chan LK, Withey S, Butler PE. Smoking and wound healing problems in reduction mammaplasty: is the introduction of urine nicotine testing justified? *Ann Plast Surg*. 2006;56:111-115.
23. Dabbah A, Lehman JA Jr, Parker MG, Tantri D, Wagner DS. Reduction mammaplasty: an outcome analysis. *Ann Plast Surg*. 1995;35:337-341.
24. Jordan SW, Mioton LM, Smetona J, et al. Resident involvement affects plastic surgery outcomes: an analysis of 10,356 patients from the NSQIP database. *Plast Reconstr Surg*. 2013;131:763-773.
25. Cunningham BL, Gear AJ, Kerrigan CL, Collins ED. Analysis of breast reduction complications derived from the BRAVO study. *Plast Reconstr Surg*. 2005;115:1597-1604.
26. Raval MV, Wang X, Cohen ME, et al. The influence of resident involvement on surgical outcomes. *J Am Coll Surg*. 2011;212:889-898.
27. Kiran RP, Ahmed Ali U, Coffey JC, Vogel JD, Pokala N, Fazio VW. Impact of resident participation in surgical operations on postoperative outcomes: national surgical quality improvement program. *Ann Surg*. 2012;256:469-475.
28. American College of Surgeons National Surgery Quality Improvement Program. http://site.acsnsqip.org/. Accessed October 1, 2012.
29. Fischer JP, Cleveland EC, Nelson JA, et al. Breast reconstruction in the morbidly obese patient: assessment of 30-day complications using the 2005 to 2010 National Surgical Quality Improvement Program data sets. *Plast Reconstr Surg*. 2013;132:750-761.
30. Fischer JP, Nelson JA, Kovach SJ, et al. Impact of obesity on outcomes in breast reconstruction: analysis of 15,937 patients from the ACS-NSQIP datasets. *J Am Coll Surg*. 2013;217:656-664.
31. Fischer JP, Nelson JA, Serletti JM, Wu LC. Peri-operative risk factors associated with early tissue expander (TE) loss following immediate breast reconstruction (IBR): a review of 9305 patients from the 2005-2010 ACS-NSQIP datasets. *J Plast Reconstr Aesthet Surg*. 2013;66:1504-1512.
32. Fischer JP, Wes AM, Tuggle CT, 3rd, Serletti JM, Wu LC. Risk analysis of early implant loss after immediate breast reconstruction: a review of 14,585 patients. *J Am Coll Surg*. 2013;217:983-990.
33. Fischer JP, Wes AM, Tuggle CT, Serletti JM, Wu LC. Risk analysis and stratification of surgical morbidity after immediate breast reconstruction. *J Am Coll Surg*. 2013;217:780-787.
34. Webb ML, Cerrato F, Rosen H, DiVasta AD, Greene AK, Labow BI. The effect of obesity on early outcomes in adolescents undergoing reduction mammaplasty. *Ann Plast Surg*. 2012;68:257-260.
35. Flegal K, Carroll M, Kuczmarski R, Johnson C. Overweight and obesity in the United States: prevalence and trends, 1960-1994. *Int J Obes Relat Metab Disord*. 1998;22:39-47.
36. Fischer JP, Nelson JA, Sieber B, et al. Free tissue transfer in the obese patient: an outcome and cost analysis in 1258 consecutive abdominally based reconstructions. *Plast Reconstr Surg*. 2013;131:681e-692e.
37. Xing L, Culbertson EJ, Wen Y, Robson MC, Franz MG. Impaired laparotomy wound healing in obese rats. *Obes Surg*. 2011;21:1937-1946.
38. Yosipovitch G, DeVore A, Dawn A. Obesity and the skin: skin physiology and skin manifestations of obesity. *J Am Acad Dermatol*. 2007;56:901-916.

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