The Impact of Age on Outcomes Following Reduction Mammaplasty

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Background: Age-related physiological changes may influence surgical outcomes following breast reduction. This study investigates the association between patient age and postoperative complications using a large institutional cohort.

Methods: We retrospectively reviewed 985 patients who underwent bilateral reduction mammaplasty between 2002 and 2024 by a single surgeon. Patients were stratified by age into 3 groups: <31, 31 to 50, and >50 years. Baseline demographics, comorbidities, surgical techniques, and complication rates were analyzed. Univariable and multivariable logistic regression was used to assess associations between age and minor and major complications, adjusting for diabetes, hypertension, smoking history, and prior radiation.

Results: Our patient cohort's mean age was 39.3 (13–76) years. A total of 276 (28.0%) had either a minor or major complication. The minor complications across the cohort (154) included seroma, skin necrosis, delayed wound healing, infection, nipple necrosis, hematoma, and fat necrosis. Major complications (122) included cases requiring readmission and/or reoperation. Patients in the 31- to 50-year age group were more likely to have a minor complication (17.9%) compared to those in the <31-year age group (13.1%) ($P = 0.05$). Patients aged 31 to 50 years (13.0%) and >50 years (18.7%) were more likely to develop major complications than those aged <31 years (6.56%) ($P < 0.05$ and $P = 0.0001$, respectively). The >50-year age group was more likely to be readmitted (7.4% vs 1.3%, $P = 0.05$) and reoperated (11.3% vs 5.3%, $P < 0.05$) compared to the <31-year age group. However, no statistically significant relationship was found with minor or major complication rates in senior groups with age ≥ 60 years. In adjusted models, age was not an independent predictor of minor or major complications; instead, diabetes (minor; odds ratio, 1.80; 95% confidence interval, 1.04–3.07; $P = 0.03$) and smoking (major; odds ratio, 2.16; 95% confidence interval, 1.12–3.98; $P = 0.02$) were associated with increased risk.

Conclusion: Older patients show higher unadjusted morbidity after reduction mammaplasty, but age itself is not an independent risk factor once comorbidities are considered. Preoperative counseling and optimization should prioritize diabetes, hypertension, and smoking over rigid age thresholds.

Key Words: age factors, breast reduction, comorbidities, complications, reduction mammaplasty

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Reduction mammaplasty is a commonly performed procedure that reliably alleviates the musculoskeletal and psychosocial burden of macromastia and improves quality of life across patient populations.[1–3] Despite its benefits, uncertainty persists regarding whether patient age independently influences perioperative outcomes. Older patients may present with physiologic changes and comorbidities that could predispose them to complications, whereas younger patients are sometimes restricted from surgery by arbitrary age-based criteria despite substantial symptom burden.[4,5]

Prior studies have produced conflicting evidence. Some have reported higher complication rates in older patients, whereas others attribute risk to comorbid factors such as obesity, diabetes, and smoking —well-established contributors to impaired wound healing.[6–8] These disparate findings make it unclear whether chronological age functions as an independent predictor or simply a surrogate for comorbidity burden. This study leverages a large, single-surgeon cohort spanning more than 2 decades to evaluate the association between age and postoperative complications following bilateral reduction mammaplasty. We hypothesize that age would not independently predict morbidity after adjustment and that comorbidities would serve as stronger drivers of adverse outcomes.

METHODS

Patients and Methods

This study was approved by the institutional review board (STUDY00007792). We conducted a retrospective review of all consecutive patients who underwent bilateral reduction mammaplasty at a single academic institution between 2002 and 2024. All procedures were performed by a single surgeon (A.L.) using consistent operative technique across the study period. Patients were included if age at the time of surgery was documented and if follow-up information was available. Exclusion criteria included incomplete medical records with missing age data, absence of postoperative follow-up, or history of prior reduction mammaplasty performed at an outside institution.

Patients were stratified into 3 age groups for primary analysis: <31, 31 to 50, and >50 years. These cutoffs were selected to distribute patients most evenly across categories in our dataset, consistent with prior breast reduction outcomes studies that examined outcomes across age thresholds (eg, <40 years, 40–50 years, >50 years).[9] In addition, a secondary analysis was performed for patients aged ≥60 years ("senior subgroup").

Baseline demographic and clinical variables extracted included body mass index (BMI), diabetes, hypertension, smoking status (active or prior history), prior radiation exposure, and operative variables such as pedicle type, operative time, estimated blood loss, and nipple-to-notch distance for each breast.

Operative Technique

All procedures were performed by a single surgeon using a consistent operative approach. The majority of reductions were performed with a superomedial pedicle (67%; Table 1), based on the second and third superficial branches of the internal mammary artery, which provides robust perfusion to the nipple-areolar complex.[10] The pedicle was designed with a 6- to 8-cm base and sharply deepithelialized. Incisions were deepened with electrocautery to the chest wall without exposing the pectoralis fascia, and the lateral breast flap was elevated at a thickness of 1 to 2 cm to preserve vascularity. Resection was carried out primarily from the inferior and lateral quadrants, with limited medial resection to maintain breast contour. The pedicle was then rotated superiorly and laterally into an inverted crescentic space, allowing a tension-free inset of the nipple-areolar complex

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TABLE 1. Demographics and Baseline Clinical Characteristics Based on Ages of <31, 31–50, and >50 Years

Variable	Category	<31 y (n = 320)	31–50 y (n = 408)	>50 y (n = 257)
Hypertension	Yes	15	100	138
	No	305	308	119
Diabetes	Yes	10	40	51
	No	310	368	206
Smoking	Yes	16	49	30
	Prior history	6	31	21
	No	298	328	206
Radiated tissue history	Yes	0	1	5
	No	320	407	252
Left pedicle type	Superomedial	214	271	173
	Inferior	68	89	47
	Others	38	48	37
Right pedicle type	Superomedial	215	273	172
	Inferior	70	89	48
	Others	35	46	37
BMI category	Normal (18.5–24.9)	62	23	29
	Overweight (25–29.9)	68	68	58
	Obese I (30–34.9)	74	113	71
	Obese II (35–39.9)	65	112	59
	Obese III (≥40)	51	82	40
Minor: seroma	-	7	7	5
Skin necrosis	-	0	1	3
Delayed healing	-	18	44	13
Infection	-	7	9	10
Nipple necrosis	-	1	3	3
Hematoma	-	5	3	1
Fat necrosis	-	4	6	4
Major: readmission	Seroma	0	2	2
	Skin necrosis	0	0	2
	Delayed healing	0	0	0
	Infection	1	3	8
	Fat necrosis	0	3	1
	Hematoma	2	2	4
	Other	1	2	2
Time elapsed for readmission (SD), d	-	0.17 (1.34)	4.06 (30.93)	14.3 (90.71)
Major: reoperation	Skin necrosis	0	0	2
	Delayed healing	2	3	6
	Infection	2	3	3
	Nipple necrosis	0	1	0
	Hematoma	7	9	7
	Fat necrosis	1	8	4
	Cosmetics	4	14	7
	Other	1	3	0
Time elapsed for reoperation (SD), d	-	24.7 (204.17)	31.32 (94.4)	420.04 (153.2)

BMI, body mass index.

(NAC). Skin excision was most commonly performed with a Wise pattern, and closure was layered to optimize contour and reduce wound tension.[10] An inferior pedicle (21%) was employed selectively in patients with specific anatomic considerations, but the superomedial pedicle remained the predominant technique across the cohort (Table 1).

Outcomes

Outcomes of interest included postoperative complications, categorized as minor (not requiring readmission or reoperation) or major (requiring readmission or reoperation). Minor complications included seroma, skin necrosis, delayed wound healing, infection, nipple necrosis, hematoma, and fat necrosis. Major complications included any event necessitating hospital readmission or reoperation because these events represent clinically significant deviations from expected postoperative recovery and reflect complications with functional, infectious, or aesthetic consequences necessitating acute surgical management. Furthermore, many of the major complications included failed conservative management or lack of improvement of complications. The specific

causes for readmission and reoperation are presented in Table 1. Cosmetic revisions were analyzed within the reoperation category. For each patient, the time from index operation to readmission or reoperation was also recorded.

Statistical Analysis

Descriptive statistics were calculated for demographic, clinical, and operative variables. Frequency analysis and chi-square testing were used to compare categorical variables. Univariate logistic regression was performed to evaluate associations between age groups and binary outcomes (minor complication, major complication). Multinomial regression was used for multicategory outcomes (readmission, reoperation). Multivariable regression models were adjusted for diabetes, hypertension, smoking status, prior smoking history, and prior radiation exposure, selected based on clinical relevance as established predictors of impaired wound healing and comorbidities that accumulate with age.[6] Analyses were conducted in R version 4.3.1, and statistical significance was defined as $\alpha = 0.05$.

RESULTS

Cohort Characteristics

Between 2002 and 2024, 985 patients (1970 breasts) underwent bilateral reduction mammaplasty by a single surgeon. Patients were stratified by age: <31 years (n = 320), 31 to 50 years (n = 408), and >50 years (n = 257). The mean age was 39.3 years (range, 13–76 years).

Comorbidities increased with age: hypertension rose from 4.7% in patients < 31 years old to 53.7% in those >50 years old, and diabetes rose from 3.1% to 19.9%. Smoking prevalence was 5.0% (<31 years old), 12.0% (31–50 years old), and 11.7% (>50 years old). Prior radiation exposure was uncommon across groups. Substantial representation of patients with obesity (classes I–III) was present in all cohorts. Pedicle selection was consistent, with the superomedial pedicle used in two-thirds of cases (Table 1).

Regression Analyses (Univariable)

Overall, 276 patients (28.0%) experienced at least 1 complication, of which 154 were minor and 122 were major. Delayed wound healing and infection were the most frequent minor events, whereas hematoma and cosmetic revision predominated among reoperations. Crude complication rates rose with age: major complications (readmission or reoperation) occurred in 6.6% of patients < 31 years old, 13.0% of those 31 to 50 years old ($P < 0.05$), and 18.7% of those > 50 years old ($P = 0.0001$). When analyzed separately, readmission (7.4% vs 1.3%, $P = 0.05$) and reoperation (11.3% vs 5.3%, $P < 0.05$) were also higher in patients > 50 years old compared with those < 31 years old. In the senior subgroup (≥60 years old, n = 83), complication rates were further elevated, although differences did not reach statistical significance (Table 2).

On regression analyses, age of 31 to 50 years was associated with increased odds of both minor (odds ratio [OR], 1.48; 95% confidence interval [CI], 0.9997–2.24; $P = 0.05$) and major (OR, 1.88; 95% CI, 1.08–3.37; $P = 0.02$) complications. Age > 50 years was significantly associated with major complications (OR, 2.57; 95% CI, 1.44–4.71; $P = 0.0001$) and reoperation (OR, 1.90; 95% CI, 1.006–3.70; $P = 0.04$) (Table 3).

Multivariate Analysis

After adjusting for diabetes, hypertension, smoking, prior smoking history, and prior radiation exposure, age was not an independent predictor of complications. Instead, diabetes was associated with an increased risk of minor complications (OR, 1.80; 95% CI, 1.04–3.07; $P = 0.03$). Active smoking (OR, 2.16; 95% CI, 1.12–3.98; $P = 0.02$) and prior smoking history (OR, 2.56; 95% CI, 0.90–6.35; $P = 0.05$) predicted major complications. Hypertension was associated with higher odds of readmission (OR, 1.60; 95% CI, 1.10–2.58; $P = 0.04$), whereas smoking was predictive of reoperation.

DISCUSSION

This study evaluates the impact of age on postoperative outcomes following bilateral reduction mammaplasty in nearly 1000 patients over 2 decades. On univariable analysis, patients over 50 years old demonstrated higher rates of major complications (driven by increased readmission and reoperation) compared to younger cohorts. However, after adjusting for comorbidities, age was not an independent predictor of adverse outcomes. Instead, comorbidities that accumulate with age, such as diabetes, hypertension, and smoking, emerged as the principal drivers of adverse events. These findings reinforce that chronological age alone is a poor proxy for physiological vulnerability and that modifiable health factors remain most relevant determinants of postoperative outcomes.[6,7]

Prior studies evaluating the role of age in reduction mammaplasty have reported conflicting results. Shermak et al[9] reported age > 50 years as an independent predictor of postoperative infection. Payton et al[11] similarly found that increasing age remained an independent predictor of minor complications—defined as nonoperative wound-related events—after multivariable adjustment, a pattern consistent with our own crude analyses prior to adjustment. However, several studies have demonstrated that age loses significance once comorbidities and technical factors are considered. Recent meta-analyses by Liu et al[12] and Myung and Heo[13] have shown that obesity, smoking, diabetes, and large resection weight are consistent predictors of complications, whereas age alone does not confer added risk. Similarly, studies evaluating institutional and national datasets reported that body mass index, resection weight, and smoking status were more robust predictors of morbidity than age alone.[14–16] Our findings align with this contemporary body of evidence: although crude major complication rates were higher in older patients, age was not independently associated with morbidity after adjustment, reinforcing that comorbidity burden—rather than

TABLE 2. Patient Numbers and Complication Rates Stratified Into Age Groups

Age Groups, y	Total Minor Complication	Total Major Complication	Readmission	Reoperation
<31 (n = 320)	42 (13.1%)	21 (6.56%)	4 (1.25%)	17 (5.31%)
31–50 (n = 408)	73 (17.9%)*	53 (13.0%)†	12 (2.94%)	41 (10.0%)
>50 (n = 257)	39 (15.2%)	48 (18.7%)‡	19 (7.39%)*	29 (11.3%)†
Senior group: ≥60 (n = 83)	8 (9.64%)	20 (24.1%)	9 (10.8%)	11 (13.3%)

*$P = 0.05$.
†$P < 0.05$.
‡$P = 0.0001$.

TABLE 3. Regression Analyses Evaluating the Association Between Age and Outcomes

	Minor Complication		Major Complication		Readmission		Reoperation	
Variable	**OR (95% CI)**	***P***	**OR (95% CI)**	***P***	**OR (95% CI)**	***P***	**OR (95% CI)**	***P***
31–50 y	1.48 (0.9997–2.24)	0.05*	1.88 (1.08–3.37)	0.02*	2.06 (0.39–10.7)	0.38	1.7 (0.95–3.24)	0.07
>50 y	1.32 (0.83–2.1)	0.23	2.57 (1.44–4.71)	0.0001*	4.7 (0.97–23.06)	0.053*	1.9 (1.006–3.7)	0.04*
≥60 y	0.5 (0.23–1.08)	0.1	1.8 (0.92–3.5)	0.06*	3.18 (0.86–11.67)	0.08	1.23 (0.5–2.8)	0.64

Values with asterisks indicate statistical significance.

CI, confidence interval; OR, odds ratio.

chronological age—remains the dominant determinant of postoperative risk.

Several physiologic mechanisms may explain the discrepancy between crude age-related differences in complications and the loss of significance after adjustment for comorbidities. Shermak et al[9] proposed that declining estrogen levels may impair collagen synthesis and angiogenesis, contributing to higher rates of infection in older patients. Although age-related reductions in vascularity, dermal thickness, and tissue elasticity may modestly affect wound healing, these changes may generally be outweighed by the impact of modifiable comorbidities. Smoking, for example, has well-described microvascular consequences, including impaired oxygen delivery, endothelial dysfunction, and reduced perfusion, that significantly increase the risk of wound breakdown, infection, and necrosis.[6] Similarly, diabetes has been described as significant predictor of wound-related complications.[12] These mechanisms help explain why older patients, who more frequently harbor these comorbidities, exhibited higher crude complication rates, yet chronological age alone did not independently predict morbidity after adjustment. The pattern observed in our cohort supports the interpretation that physiologic vulnerability is better captured by comorbidity burden than by age itself.

These findings have several implications for clinical practice. Although older patients demonstrated higher crude rates of readmission and reoperation, surgeons may exercise greater caution with postoperative monitoring in this population, particularly when additional medical or social factors raise concern for recovery support. The multivariate results underscore the importance of optimizing modifiable comorbidities (diabetes, hypertension, and smoking status) as these factors, rather than age, were the principal predictors of major morbidity in our cohort. In our institutional practice, all patients were counseled to discontinue nicotine use at least 6 weeks prior to surgery, consistent with established protocol. However, although smoking cessation is always preferred, in select cases requiring a superomedial pedicle, where limited undermining reduces the risk of vascular compromise, the surgical team occasionally proceeded in carefully chosen patients who had not fully quit despite counseling.[10] This reflects a nuanced, case-by-case judgment balancing symptom burden, safety considerations, and technical factors. Moving forward, the present findings, together with existing literature identifying smoking as one of key determinants of postoperative risk, suggest that stricter adherence to preoperative optimization protocols may further reduce major complications and support more standardized risk assessment across age groups. Furthermore, focusing on patient comorbidities, such as smoking, diabetes, and hypertension, during preoperative counseling should be the main focus to avoiding complications rather than associating adverse outcomes solely with age.

Beyond medical comorbidities, nonclinical factors also influence postoperative recovery and should be incorporated into preoperative counseling. Prior work has shown that patients with limited social support experience higher rates of wound-related complications and unplanned healthcare utilization, underscoring the role of home support in determining postoperative resilience.[17] These considerations may intersect with age, as older adults may more likely face caregiving limitations, which may contribute to the more cautious postoperative management often employed in this group. Our findings reinforce the importance of a comprehensive, individualized risk assessment that incorporates not only comorbidities such as diabetes, hypertension, and smoking status but also functional status, recovery environment, and patient goals. Such an approach supports shared decision-making and ensures that candidacy for reduction mammaplasty is guided by physiologic and contextual risk rather than chronological age alone.

Study Limitations

This study has several limitations. Its retrospective design is subject to inherent selection and information biases, and although the single-surgeon setting strengthens internal consistency in technique, it may limit generalizability to broader practice patterns. The relatively small number of patients aged ≥60 years reduced statistical power for subgroup analysis, which may have obscured age-associated differences detectable in larger cohorts. Although we adjusted for major comorbidities known to influence postoperative outcomes, residual confounding variables from unmeasured clinical or social factors cannot be excluded. Finally, although our dataset spans more than 2 decades, changes in perioperative care pathways or outpatient support over time may also have influenced outcomes. Larger multicenter studies will be important to validate these findings and further refine risk profiles for older adults undergoing reduction mammaplasty.

CONCLUSION

Although older patients exhibited higher crude rates of major complications following reduction mammaplasty, chronological age was not an independent predictor of morbidity after adjustment. Instead, comorbidities such as diabetes, hypertension, and smoking status remained the principal determinants of postoperative risk. These findings reinforce that surgical candidacy and perioperative planning should focus on comorbidity optimization and individualized assessment rather than age-based thresholds. Reduction mammaplasty can be performed safely across age groups when modifiable risk factors are addressed, supporting a more nuanced, patient-centered approach to preoperative counseling and risk stratification.

REFERENCES

1. Holt DR, Kirk SJ, Regan MC, et al. Effect of age on wound healing in healthy human beings. *Surgery*. 1992;112:293–297.
2. Birtchnell S, Whitfield P, Lacey JH. Motivational factors in women requesting augmentation and reduction mammaplasty. *J Psychosom Res*. 1990;34:509–514.
3. Fischer JP, Cleveland EC, Shang EK, et al. Complications following reduction mammaplasty: a review of 3538 cases from the 2005–2010 NSQIP data sets. *Aesthet Surg J*. 2014;34:66–73.
4. Gosain A, DiPietro LA. Aging and wound healing. *World J Surg*. 2004;28:321–326.

5. Nuzzi LC, Pramanick T, Walsh LR, et al. Optimal timing for reduction mammaplasty in adolescents. *Plast Reconstr Surg*. 2020;146:1213–1220.
6. Sorensen LT. Wound healing and infection in surgery: the pathophysiological impact of smoking, smoking cessation, and nicotine replacement therapy: a systematic review. *Ann Surg*. 2012;255:1069–1079.
7. Xue DQ, Qian C, Yang L, et al. Risk factors for surgical site infections after breast surgery: a systematic review and meta-analysis. *Eur J Surg Oncol*. 2012;38: 375–381.
8. Shah R, Al-Ajam Y, Stott D, et al. Obesity in mammaplasty: a study of complications following breast reduction. *J Plast Reconstr Aesthet Surg*. 2011;64:508–514.
9. Shermak MA, Chang D, Buretta K, et al. Increasing age impairs outcomes in breast reduction surgery. *Plast Reconstr Surg*. 2011;128:1182–1187.
10. Faulkner HR, Merceron T, Wang J, et al. Safe reproducible breast reduction. *Plast Reconstr Surg Glob Open*. 2023;11:e5245.
11. Payton JI, Abraham JT, Novak MD, et al. Impact of age, body mass index, and resection weight on postoperative complications in reduction mammaplasty. *Plast Reconstr Surg*. 2023;151:727–735.
12. Liu D, Wu M, Xu X, et al. Risk factors and complications in reduction mammaplasty: a systematic review and meta-analysis. *Aesthetic Plast Surg*. 2023;47:2330–2344.
13. Myung Y, Heo CY. Relationship between obesity and surgical complications after reduction mammaplasty: a systematic literature review and meta-analysis. *Aesthet Surg J*. 2017;37:308–315.
14. Nelson JA, Fischer JP, Wink JD, et al. A population-level analysis of bilateral breast reduction: does age affect early complications? *Aesthet Surg J*. 2014;34: 409–416.
15. Aravind P, Siotos C, Bernatowicz E, et al. Breast reduction in adults: identifying risk factors for overall 30-day postoperative complications. *Aesthet Surg J*. 2020; 40:NP676–NP685.
16. Wirthmann AE, Welsch L, Wellenbrock SV, et al. Reduction mammoplasty in adolescents and elderly: a ten year case series analyzing age related outcome with focus on safety and complications. *J Plast Reconstr Aesthet Surg*. 2018;71:377–383.
17. Roth J, Yu BZ, Fung E, et al. Social support holds protective value in breast reconstruction. *J Plast Reconstr Aesthet Surg*. 2025;106:213–220.