

Quantifying Surgical Complications for Reduction Mammoplasty in Adolescents

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PATIENT
SAFETY



Background: Reduction mammoplasty is a safe, effective procedure to alleviate symptoms of adolescent macromastia. However, there remain limited data on surgical complications associated with reduction mammoplasty in adolescents, which may not be concordant with those cited for adults seeking reduction mammoplasty.

Methods: A retrospective review was conducted of all consecutively performed reduction mammoplasty cases for symptomatic macromastia in patients aged 20 years and younger over a 7-year period from 2014 to 2021.

Results: One hundred sixty total breasts were analyzed in 80 patients. Mean age was 18.3 ± 1.4 years, with an age range from 15 to 20 years. Mean body mass index was 27.17 ± 5.49 kg/m². Mean reduction weight was 584.79 ± 261.19 g. A medial pedicle was used in 91%, and an inferior pedicle was used in 9%. For skin incision, a Wise pattern was used in 60%, and a short-scar was used in 40%. There was a 16.3% rate of any surgical complication, which included wound healing by secondary intention treated with local wound care. There were no significant risk factors for a surgical complication in reduction mammoplasty, and no differences in surgical complications related to skin incision type, pedicle use, or breast reduction weight. Performance of a receiver operating characteristic curve for age at surgery and complication demonstrated that there was no age cutoff where the risk of surgical complication was appreciably increased or decreased.

Conclusions: Age was not identified as a risk factor for surgical complications in adolescent reduction mammoplasty. Overall, complication rates were very low and minor in nature for adolescent reduction mammoplasty, with no significant risk factors identified. (*Plast. Reconstr. Surg.* 151: 376e, 2023.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Risk, III.

Reduction mammoplasty is a safe, effective procedure to alleviate physical and psychosocial symptoms of adolescent macromastia. These symptoms include headache, backache, neck or shoulder pain, chronic breast pain, shoulder grooving from bra straps, and rash or intertrigo. Patients may also experience discomfort while exercising, difficulty finding comfortable clothing or bras, and low self-esteem. Adolescents with macromastia in particular may suffer from embarrassment or unwanted attention because of their breast size. These patients also report higher rates of depression, anxiety, and even eating

disorders compared to their peers.¹ Causes of macromastia in the adolescent population include not only adolescent macromastia (i.e., hypertrophy of glandular breast tissue), but also juvenile gigantomastia and obesity-related breast hypertrophy.² Numerous studies have demonstrated the significant negative impact of macromastia on adolescent quality of life, physical symptoms, and self-esteem.¹⁻⁴

Disclosure: *The authors have no financial interests to declare.*

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Breast reduction remains one of the most commonly performed reconstructive plastic surgery procedures in the United States.⁵ Adolescents who undergo reduction mammoplasty experience sustained improvements in their physical and psychosocial well-being for years after surgery.^{6,7} Although approximately 80% of women with macromastia have been symptomatic since their teenage years, most women undergoing reduction mammoplasty are 40 to 60 years of age at the time of surgery.³ Notably, women who seek reduction mammoplasty report a similar preoperative symptom burden across a wide range of breast sizes, and the symptomatic benefits derived from reduction mammoplasty are comparable among women of different sizes.^{8,9}

Despite the well-documented benefits of reduction mammoplasty, this procedure remains controversial in the adolescent population. Concerns in adolescent breast reduction include the risk of altered breast or nipple sensation, potential impaired breastfeeding, altered breast morphology after pregnancy, and the potential for breast regrowth requiring revision surgery. Some medical providers and insurance companies continue to implement arbitrary age cutoffs for breast reduction surgery.⁵ Very recently, a study of breast size stability in adolescents seeking reduction mammoplasty demonstrated that the incidence of breast regrowth after reduction mammoplasty is relatively low in this population.¹⁰ However, there remain limited data on surgical complications associated with reduction mammoplasty in adolescents, which may not be concordant with those cited for adults seeking reduction mammoplasty. To that end, we sought to quantify the surgical outcomes of reduction mammoplasty among a cohort of adolescent and young adult patients at our institution.

PATIENTS AND METHODS

A retrospective cohort review was conducted of all consecutively performed reduction mammoplasty cases for symptomatic macromastia in patients aged 20 years and younger at the time of surgery at a single institution in a large metropolitan city by two plastic surgeons over a 7-year period from January 1, 2014, to January 1, 2021. This research was approved by the institutional review board at New York University Langone Health (study number s18-01593). There were no exclusion criteria.

The following demographic information was collected: age at the time of surgery, sex, race,

body mass index, smoking history, diabetes mellitus, medical diagnosis, history of chemotherapy, history of radiation therapy, history of breast augmentation, history of breast reduction or mastopexy, preoperative imaging or mammography, personal history of breast cancer, first- and second-degree family history of breast cancer, preoperative bra size, cup size, preoperative breast measurements, genetic markers, and preoperative estimated reduction weight. Operative variables included final reduction weight, pedicle type, skin incision type, and reduction specimen pathologic findings. Postoperative complications included nipple necrosis, wound healing complications, scar intervention, fat necrosis, seroma, hematoma, pulmonary embolism, and revision operations. Of note, any wound healing by secondary intention treated with local wound care was included as a complication. In addition, postoperative scar intervention as a complication included scar revision, dog-ear excision, Kenalog injection, or any type of post-index breast reduction procedure (including injections, office procedure revision, or surgical/operating room scar revision) to improve the appearance of scars.

Patient demographics and baseline characteristics were summarized using appropriate descriptive statistics. The frequency and percentage of operations with complications were summarized overall and by complication type. Univariate associations with any surgical complication outcome were investigated for the following factors: estimated and actual reduction weights and their difference, preoperative breast measurements, pedicle type, skin pattern incision type, and pseudoangiomatic stromal hyperplasia (PASH) on breast reduction pathology evaluation. Fisher exact or Pearson chi-square tests were performed to determine whether nominal associations existed with any surgical complication. Mann-Whitney *U* tests were performed to compare mean values of numeric data for equality between those operations with a complication and those without. Given our sample size, we performed further analysis to compare our adult symptomatic macromastia patient cohort (21 years of age or older) to our adolescent symptomatic macromastia patient cohort in terms of surgical complications, including even any wound healing by secondary intention as a complication. Finally, a receiver operating characteristic (ROC) curve was determined for the factor of age at the time of surgery. Area under the curve with respect to surgical complication outcomes was calculated and compared to 0.5. This allowed

for investigation into whether an appropriate age cutoff should be considered when performing reduction mammoplasty in adolescents because of increased complication risk. All statistical analyses were performed using IBM SPSS version 25.0 (IBM Corp., Armonk, NY). Values of $P < 0.05$ by means of two-sided testing were considered statistically significant.

RESULTS

Patient Demographics and Surgical Factors

One hundred sixty total breasts were analyzed in 80 patients (Table 1). Mean age at the time of surgery was 18.3 ± 1.4 years, with an age range from 15 to 20 years. Mean body mass index was 27.17 ± 5.49 kg/m². Mean reduction weight was 584.79 ± 261.19 g. Median length of follow-up time was 717.0 days (interquartile range, 217.5 to 1410.0 days). A medial pedicle was used in 146 (91%), and an inferior pedicle was used in 14 (9%). For skin incision, a Wise pattern was used in 96 (60%), and a short-scar was used in 64 (40%). Regarding breast reduction specimen pathologic findings, 18 breasts (11%) were notable for PASH.

Surgical Complications

There was a 16.3% rate of any surgical complication, which included any wound healing by secondary intention treated with local wound care (Table 2). Specifically, the rates of complications were as follows: postoperative scar intervention,

Table 2. Surgical Complications

Variable	No. (%)
No.	160
Any surgical complication	26 (16.3)
Nipple	
Partial necrosis	1 (0.6)
Full necrosis	0
Wound healing complication	9 (5.6)
Scar or wound with intervention	13 (8.1)
Fat necrosis with intervention	0
Seroma	3 (1.9)
Hematoma	1 (0.6)
Pulmonary embolism	0
Revision operations/OR	1 (0.6)

OR, operating room.

8.1% ($n = 13$); wound healing complications, 5.6% ($n = 139$); seroma, 1.9% ($n = 3$); partial nipple necrosis, 0.6% ($n = 1$); hematoma, 0.6% ($n = 1$); and revision surgery, 0.6% ($n = 1$). There were no cases of full-thickness nipple necrosis, no interventions for fat necrosis, and no pulmonary embolisms. In univariate analysis, there were no significant risk factors for a surgical complication in reduction mammoplasty (Table 3). Notably, there were no differences in surgical complications related to skin incision type, pedicle use, or breast reduction weight. No patients required secondary breast reduction.

Given our sample size, we performed further analysis to compare our adult symptomatic macromastia patient cohort (21 years of age or older) to our adolescent symptomatic macromastia patient cohort in terms of surgical complications, including any wound healing by secondary intention as a complication. Our adult symptomatic macromastia patient cohort (21 years of age or older) had a complication rate of 21.9% (101 of 462 breasts) compared to our adolescent cohort that had a complication rate of 16.3% (26 of 160 breasts), which yielded $P = 0.129$. The post hoc power is 0.318 to detect a difference between our adult and adolescent patient populations. Thus, in our large institutional experience, adolescent reduction mammoplasty cases are associated with a lower complication rate than adult reduction mammoplasty cases for symptomatic macromastia.

Age at Surgery and Risk of Surgical Complications

To evaluate whether an appropriate age cutoff should be considered when performing reduction mammoplasty because of increased complication risk, a ROC curve was calculated for the factor of age at the time of surgery (Fig. 1). Regarding the rationale for the ROC curve, the age range of 15 to 20 years represents

Table 1. Adolescent Patient Demographics

Variable	Study Cohort (%)
No.	80
Age, yr	
Mean \pm SD	18.3 ± 1.43
Range	15–20
BMI, kg/m ²	
Mean \pm SD	27.17 ± 5.49
Range	19.11–42.36
Race	
African American	12 (15.0)
White	60 (75.0)
Other/Hispanic	2 (2.5)
Other/Puerto Rican	6 (7.5)
Current or former tobacco user	4 (5.0)
Diabetic	3 (3.8)
Diagnosis	
Macromastia	80 (100)
First-degree family history of breast cancer	1 (1.3)
Second-degree family history of breast cancer	3 (3.8)
Length of follow-up, days	
Median	717.0
IQR	217.75–1410

BMI, body mass index; IQR, interquartile range.

Table 3. Univariate Risk Analysis for Any Surgical Complication

Variable ^a	No Surgical Complication	Surgical Complication	P ^b
No.	134	26	
Operative reduction weight, g			0.935
Median	538.5	545.5	
IQR	404.5–728.25	382.3–683	
Preoperative estimated reduction weight, g			0.903
Median	700.0	750.0	
IQR	600.0–900.0	500–837.5	
Operative – preoperative estimated reduction weight, g			0.361
Median	–172.0	–149.0	
IQR	–285.75 to –92.5	–258.0 to –66.5	
Wise pattern incision	82 (85.4)	14 (14.6)	0.484
Short-scar incision	52 (81.3)	12 (18.7)	0.484
PASH pathology			1.000
No	119 (83.8)	23 (16.2)	
Yes	15 (83.3)	3 (16.7)	
Pedicle type			1.000
Inferior pedicle	12 (85.7)	2 (14.3)	
Medial pedicle	122 (83.6)	24 (16.4)	
Breast base width, cm			0.892
Median	18.0	19.0	
IQR	17.0–19.75	16.0–20.0	
Sternal notch-to-nipple distance, cm			0.184
Median	29.0	30.0	
IQR	27.0–31.0	26.4–35.5	
Nipple-to-IMF distance, cm			0.198
Median	12.0	12.0	
IQR	10.0–13.25	11.0–15.0	

IQR, interquartile range; IMF, inframammary fold.

^aMeasurement unit: breast.

^bFrom Fisher exact test or χ^2 test for categorical data; from Mann-Whitney *U* test for numeric data.

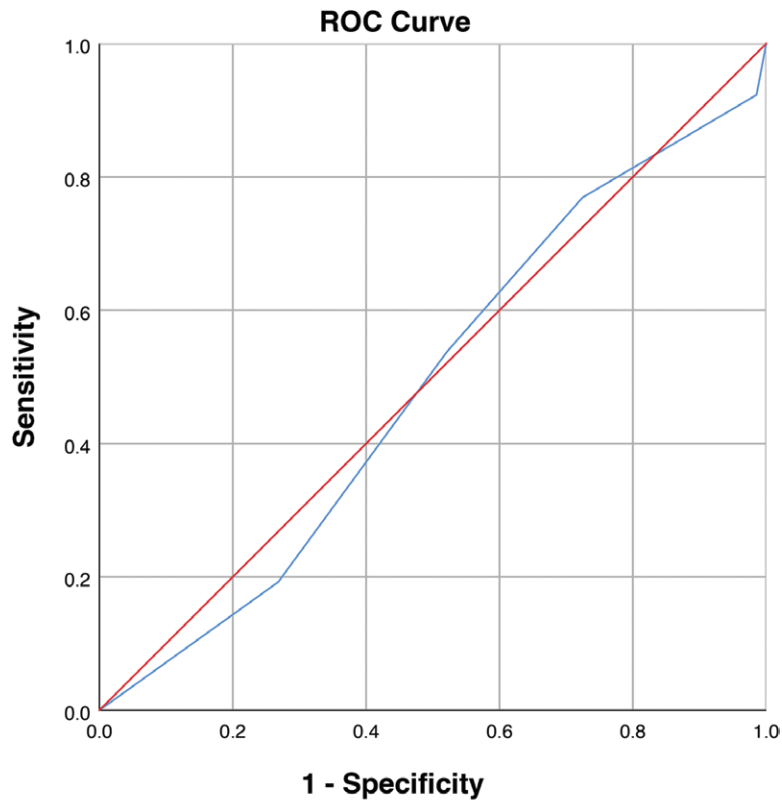
a wide formative time period, and we sought to determine whether an age cutoff existed below which we would not advise the surgery because of complication risk. Thus, a ROC curve analysis was used to identify whether a cutoff age was identifiable because of increased risk. The area under the ROC curve for age at surgery and complication was indistinguishable from 0.5. Thus, there was no age cutoff at which the risk of surgical complication was appreciably increased or decreased.

DISCUSSION

In this retrospective study of reduction mammoplasty in adolescent and young adult patients at our institution, overall surgical complication rates were very low and minor in nature. Notably, age was not identified as a risk factor for surgical complications in reduction mammoplasty. These findings suggest that age alone should not pose a barrier to care in adolescent macromastia patients, who are otherwise appropriate candidates for surgical breast reduction. Moreover, at our institution, a medial pedicle technique for reduction mammoplasty is preferred, especially in younger patients (91% in this adolescent cohort) to mitigate any long-term “bottoming out” effect and to optimize aesthetic breast shape.

Controversy in Adolescent Reduction Mammoplasty

Despite the symptomatic and psychosocial benefits of reduction mammoplasty, the procedure remains controversial in adolescent patients. Concerns include postoperative breast growth, surgical complications, and ability to breastfeed.^{3,6} A recent cross-sectional study of optimal timing for adolescent breast reduction found that the overall incidence of postoperative breast growth is relatively low (6%). Interestingly, the authors also observed that breast size stabilizes considerably later in obese macromastia patients compared to healthy-weight or overweight women.¹⁰ Although breast size stabilizes on average 3 years after menarche in healthy-weight and overweight patients, breast growth in obese macromastia patients may not end until 9 years after menarche. Performing reduction mammoplasty in young obese women before 9 years postmenarche was associated with a significantly higher odds of postoperative breast growth (OR, 1.19). The theoretical risk of impaired breastfeeding following reduction mammoplasty remains poorly understood. A systematic review of the effects of breast reduction on breastfeeding did not identify a significant difference in breastfeeding potential between women who underwent breast reduction and the general population.¹¹ The authors suggest that difficulties related to



Diagonal segments are produced by ties.

Area Under the Curve

Test Result Variable(s):

Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
0.493	0.060	0.915	0.375	0.611

The test result variable(s): Age at time

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

Fig. 1. To evaluate whether an appropriate age cutoff should be considered when performing reduction mammoplasty because of increased complication risk, a ROC curve was calculated for the factor of age at the time of surgery. The area under the ROC curve for age at surgery and complication was indistinguishable from 0.5. Thus, there was no age cutoff at which the risk of surgical complication was appreciably increased or decreased.

breastfeeding may be more readily explained by psychosocial issues than as surgical complications of breast reduction. It is important to note that no study to date has directly examined the effect of reduction mammoplasty on breastfeeding using a validated survey and control group.

Benefits of Adolescent Breast Reduction

Reduction mammoplasty offers numerous physical and psychosocial benefits. Somatic

symptom relief includes decreased musculoskeletal pain and headaches in addition to improved sleep and breathing. Psychosocial benefits range from increased self-esteem and sexual well-being to lower rates of depression, anxiety, and eating disorders.^{3,4,12} Reduction mammoplasty may even aid patients in achieving further weight loss because of increased ability to exercise.¹ Multiple studies of young reduction mammoplasty patients have demonstrated high long-term

patient satisfaction and improved quality of life, and these findings persist well into adulthood.^{6,7} Krucoff et al. found that decades after undergoing reduction mammoplasty at age 25 or younger, patients reported significantly greater satisfaction with breasts and sexual well-being compared to normative values using the validated BREAST-Q reduction module.⁶ Markedly, patients experienced improved health-related quality of life, regardless of whether or not they experienced a surgical complication following reduction mammoplasty.³

Complications in Breast Reduction

In our study, only 16.3% experienced any complication following reduction mammoplasty. These complications were relatively minor in nature (i.e., wound healing by secondary intention treated with local wound care), and only one patient required revision surgery in the study cohort. Specifically, the rates of complications were as follows: postoperative scar intervention, 8.1% ($n = 13$); wound healing complications, 5.6% ($n = 9$); seroma, 1.9% ($n = 3$); partial nipple necrosis, 0.6% ($n = 1$); hematoma, 0.6% ($n = 1$); and revision surgery, 0.6% ($n = 1$), with no cases of full-thickness nipple necrosis and no interventions for fat necrosis. Overall, our complication rate was very low. It is important to note that none of the patients required secondary reduction, as no patients experienced further breast development or growth following reduction mammoplasty. In our experience, the superomedial pedicle has less bottoming out over time, and has the benefit of providing medial fullness, which is more aesthetic, especially in young patients. Finally, the scar burden for a medial pedicle, vertical incision (short-scar) breast reduction is much less, which is a compelling clinical consideration in very young patients. In our series, a medial pedicle Wise pattern incision compared to a medial pedicle short-scar incision yielded no significant difference in any complications. Specifically, there was a 14.6% complication rate for medial pedicle, Wise pattern incision, with 12 of 82 breasts versus 18.8% for medial pedicle, short-scar incision, with 12 of 64 breasts ($P = 0.506$).

In the literature, the estimated rate of surgical complications for reduction mammoplasty is variable. One study reported that 14% to 53% of all breast reduction procedures will experience a complication.³ A retrospective review of

postoperative complications following reduction mammoplasty in the National Surgical Quality Improvement Program yielded an overall surgical complication rate of only 5.1%.¹³ In that study, morbid obesity, history of dyspnea, and active smoking were all associated with significantly higher odds of complication. In a prospective study of 512 adolescents and young women undergoing reduction mammoplasty, the most common complications were hypertrophic scarring (20%) and altered sensation of the nipple (8.4%) or breast (7.8%).³ Notably, in that study, age was also not associated with a significantly higher odds of complication. Indeed, performing breast reductions in younger patients may in fact be preferable because of lower rates of medical comorbidities compared to older patients. In light of the substantial benefits of breast reduction in young women and the low rate and relatively minor nature of surgical complications, we propose that age alone should not preclude young, symptomatic macromastia patients from undergoing surgical breast reduction.

Barriers to Insurance Coverage

Insurance coverage requirements for reduction mammoplasty in the United States remain arbitrary and without scientific basis, posing a significant barrier to care for young patients with macromastia. A recent cross-sectional analysis of U.S. insurance policies concluded that insurance policy criteria for reduction mammoplasty are discordant with current national recommendations and existing clinical evidence.⁵ Although it is now well established that resection volumes do not correlate with symptomatic relief,^{8,9} the authors found that the vast majority (88%) of insurance companies continue to require a minimum resection volume for coverage.⁵ Furthermore, a common criterion for coverage is the Schnur Sliding Scale, which has been proposed to determine appropriate resection volume relative to total body surface area.¹⁴ However, the validity of this tool has been questioned.⁵ The American Society of Plastic Surgeons currently advises against minimum resection volumes in reduction mammoplasty. Furthermore, more than half of insurance policies examined by Rawes et al. required age or physical maturity requirements, despite the fact that the American Society of Plastic Surgeons does *not* currently endorse such restrictions. In short, insurance policy criteria for coverage of

breast reduction surgery are largely outdated, do not correlate with symptom relief, and ultimately limit access to reduction mammoplasty.

PASH in Adolescent Patients

Interestingly, PASH was identified in 18 patients (11%) in this cohort. PASH is a benign proliferative lesion characterized by dense, collagenous stroma with slit-like spaces lined by fibroblasts. The incidence of PASH in our study is somewhat higher than prior studies. In a recent retrospective review of incidental pathologic findings in young women who underwent reduction mammoplasty, Maroney et al. reported a 1.8% incidence of PASH.¹⁵ The implications of these findings remain unclear, as guidelines do not yet exist for management of incidental pathologic breast lesions in the adolescent population. It is possible that proliferative lesions with or without atypia in adolescents and young women represent a higher risk lesion than similar pathologic diagnoses in older women, although further study is needed in this area to delineate the significance. At this time, we continue to recommend sending all breast reduction specimens for our patients for formal surgical pathologic review.

Limitations

This study has several limitations, most notably its retrospective design and small sample size at a single institution; thus, it is underpowered. Given our sample size, we performed further aforementioned analyses to compare our adult symptomatic macromastia patient cohort to our adolescent symptomatic macromastia patient cohort in terms of complications to strengthen our study. As enumerated above, the post hoc power is 0.318 to detect a difference between our adult and adolescent patient populations.

Furthermore, potential long-term complications of breast reduction, including altered nipple or breast sensation and impaired breastfeeding, were not assessed in this study. Known risk factors for poor wound healing, including smoking and diabetes, were not identified as significant risk factors for surgical complications in this study. This is likely because of the very low number of current or former tobacco users ($n = 4$) and diabetic patients ($n = 3$) in this cohort. Median follow-up time was less than 2½ years, which may not have fully captured postoperative breast growth in all patients.

CONCLUSIONS

In this retrospective study of reduction mammoplasty in adolescent and young adult patients, age was not identified as an independent risk factor for surgical complications. Overall, surgical complication rates are low and minor in nature in adolescent reduction mammoplasty, and no patients required secondary breast reduction. Age should therefore not be viewed as a deterrent when evaluating adolescent macromastia patients for surgical breast reduction. This study provides objective data on surgical complications for counseling adolescent patients and their families preoperatively, and obviates the need to cite adult reduction mammoplasty data. Surgical readiness should be evaluated on an individual basis, taking into account medical comorbidities such as diabetes and obesity, smoking status, and patient motivation.

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