

# Complications and Quality of Life following Gynecomastia Correction in Adolescents and Young Men

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**Background:** Persistent adolescent gynecomastia negatively affects health-related quality of life. Surgery results in psychosocial improvements, but the effects of postoperative complications on health-related quality of life are unknown. The authors examined whether complications following adolescent gynecomastia surgery impact postoperative health-related quality of life.

**Methods:** Patients aged 12 to 21 years who underwent surgical correction of unilateral/bilateral gynecomastia between 2007 and 2019 were enrolled ( $n = 145$ ). Relevant demographic and clinical data were obtained from medical records. Fifty-one patients completed the following surveys preoperatively, and at 6 months and 1, 3, 5, 7, 9, and 11 years postoperatively: 36-Item Short-Form Health Survey (Version 2), Rosenberg Self-Esteem Scale, and the 26-item Eating Attitudes Test.

**Results:** Within a median period of 8.6 months, 36 percent of breasts experienced at least one complication. The most common were residual tissue (12.6 percent), contour irregularities (9.2 percent), and hematomas (7.8 percent). Patients reported significant postoperative improvements in self-esteem and in seven health-related quality-of-life domains (Physical Functioning, Role-Physical, Bodily Pain, Vitality, Social Functioning, Role-Emotional, and Mental Health) at a median of 33.3 months. Postoperative survey scores did not vary by grade or procedure, or largely by body mass index category or complication status. However, patients aged younger than 17 years at surgery scored significantly higher than older patients in the Short-Form Health Survey Vitality and Mental Health domains postoperatively.

**Conclusions:** Health-related quality-of-life improvements are achievable in adolescents through surgical correction of persistent gynecomastia. Postoperatively, patients largely experienced similar health-related quality-of-life gains irrespective of complication status, grade, surgical technique, or body mass index category. Minor postcorrection complications are but do not appear to limit postoperative health-related quality-of-life benefits. (*Plast. Reconstr. Surg.* 149: 1062e, 2022.)

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Gynecomastia is prevalent among adolescents, affecting up to 69 percent of male subjects.<sup>1-8</sup> Gynecomastia may describe an enlarged breast bud with little skin excess, or a fully developed breast mound with skin excess and ptosis.<sup>5</sup> Regardless of severity, gynecomastia negatively impacts health-related quality of life during adolescence, with these effects persisting

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through adulthood.<sup>9–25</sup> The majority of adolescent cases are idiopathic, resolving spontaneously over 2 to 3 years. However, surgical correction may be warranted if gynecomastia persists, or if symptoms interfere with daily living.<sup>1,2,4,16,26</sup> Although studies are limited, data suggest that surgical management of gynecomastia improves health-related quality of life in adolescents.<sup>21</sup>

A variety of surgical techniques exist to treat gynecomastia. Persistently tender breast buds may be excised under local anesthesia, whereas severe cases may require mastectomy with skin resection or free-nipple grafting. Age of the patient, size of the breast mound, skin excess, and skin quality are several factors to account for in surgical decision-making.<sup>6,26</sup> Generally, gynecomastia surgery is safely performed in the outpatient setting. Reported complications in adolescents include seroma, hematoma, recurrence/residual tissue, surgical-site infection, hypertrophic scarring, contour irregularities, chest asymmetry, nipple inversion, and altered sensation.<sup>2,22,25,27–31</sup> Given the marked differences in gynecomastia severity and the surgical techniques used, outcome data and complication frequency may vary widely between reports.

This cohort study examined a large sample of adolescents who underwent gynecomastia surgery using various techniques. Surgical outcome data were analyzed by age, body mass index category, gynecomastia grade, and surgical technique. The impact of surgical complications on health-related quality of life was also studied. The goal of this study was to report surgical outcomes in adolescents, and to determine whether complications impact patient-reported health-related quality-of-life outcomes.

## PATIENTS AND METHODS

Approval was obtained from the Boston Children's Hospital Institutional Review Board (protocol number X08-10-0492). Between August of 2007 and December of 2019, patients aged between 12 and 21 years who underwent unilateral or bilateral gynecomastia correction under general anesthesia were prospectively or retrospectively enrolled. Gynecomastia was diagnosed based on history and physical examination (presence of palpable glandular tissue); surgery was offered to those with persistent gynecomastia (present for >3 years) that was unresponsive to weight loss and medical therapy, as appropriate. Although persistent disease qualified patients for surgery, the decision to operate was ultimately

based on patients' psychosocial and physical deficits. Patients were excluded from the study if they underwent breast bud excision under local anesthesia, had pseudogynecomastia, or had undergone previous chest surgery (including for gynecomastia).

The age range in this study represents the pubertal peak of gynecomastia incidence. Although it straddles traditional definitions of adolescence and early adulthood, emerging evidence asserts that patients aged up to 24 years be included in an extended definition of adolescence because of similarities in growth and development across this life phase.<sup>32</sup>

Written informed consent was obtained from patients (and parents/guardians, as applicable) enrolled prospectively ( $n = 87$ ). Waivers of informed consent were obtained for retrospective chart reviews of patients queried using the *International Classification of Diseases, Ninth Revision* code for breast hypertrophy (611.1), identifying 58 additional patients meeting inclusion criteria (total  $n = 145$ ). Physical evaluations for gynecomastia were performed by a single plastic surgeon (B.I.L.), who classified each breast by grade (I through IV) based on Rohrich et al.<sup>5</sup>

## Clinical Assessments

Patients were seen twice preoperatively and were asked to follow up at the following minimum time points: 1 and 3 weeks, 3 and 6 months, and 1 and 3 years, postoperatively. Height, weight, and relevant clinical data were recorded at initial intake, and at each subsequent office visit. Body mass index value and category were determined using the Centers for Disease Control and Prevention BMI Percentile Calculator for Child and Teen (patients younger than 20 years) or its Adult BMI Calculator (patients aged 20 years or older), as appropriate.<sup>33,34</sup>

## Operative Procedures

Gynecomastia correction was performed on an outpatient basis, in an operating room under general anesthesia. All patients received one preoperative dose of an intravenous antibiotic. Suction-assisted lipectomy with transareolar simple mastectomy was typically used in grade I or II patients and for some grade III patients with good skin quality. The remaining grade III, and all grade IV patients, underwent mastectomy with skin excision. Liposuction was used as necessary. Grade III patients had skin excised in circumareolar or circumvertical patterns, with a central or

superomedial pedicle. Grade IV patients typically had a circumvertical or transverse incision pattern with an inferior or superomedial pedicle. All patients who underwent free nipple grafting had grade IV gynecomastia. Drains and a compression vest were used continuously for the first week postoperatively, as necessary.

### Complications

Patients and clinical staff completed outcome forms at each postoperative visit. Complications were reported per breast, rather than per patient, to more precisely examine complication impact in applicable analyses. Complications were categorized as early or late, and minor or major (Table 1). Early complications included wound healing issues, hematomas or seromas requiring drainage, and systemic reactions. Late complications were predominantly residual tissue, sensory changes, and skin/scar irregularities. The intention was to err on the side of inclusion with respect to complication data to fully capture the impact of any/all complications on health-related quality of life. For example, if a mastectomy with skin removal was performed, the necessity of a pedicle would produce residual breast tissue. If this additional tissue substantially bothered the patient and warranted

a secondary procedure for removal, it was considered a complication. Similarly, skin-sparing procedures with incomplete skin contraction warranting secondary circumareolar skin removal to improve contour were also considered complications.

### Surveys

Prospectively enrolled patients completed three previously validated, self-administered surveys [i.e., 36-Item Short-Form Health Survey (Version 2), Rosenberg Self-Esteem Scale, and Eating Attitudes Test] preoperatively, and then at approximately 6 months and 1, 3, 5, 7, 9, and 11 years postoperatively. Eight domains (Physical Functioning, Role-Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional, and Mental Health) constitute the 36-Item Short-Form Health Survey (Version 2), with results from each transformed on a 0 to 100 scale.<sup>35,36</sup> The Rosenberg Self-Esteem Scale, scored from 10 to 40, examined general self-esteem.<sup>37</sup> For these two surveys, higher scores indicate improved severity and self-esteem, respectively. Lastly, eating attitudes were quantified using the 26-item Eating Attitudes Test, in which a score greater than or equal to 20 suggests the presence of disordered eating behaviors.<sup>38</sup> For each patient, the preoperative and most recent postoperative surveys were used in analyses. Patients were omitted from health-related quality-of-life analyses if they were missing either a baseline or a follow-up survey.

### Statistical Analyses

All data were stored securely using Research Electronic Data Capture, provided through Boston Children's Hospital. Scores for the Short-Form Health Survey, Rosenberg Self-Esteem Scale, and Eating Attitudes Test were calculated using established algorithms. IBM SPSS Version 24 (IBM Corp., Armonk, N.Y.) was used for all statistical analyses. Frequencies were tabulated for demographics, procedural details, and complications, whereas mean and median were calculated for continuous variables, as appropriate. The following variables were dichotomized, unless stated otherwise: age (<17 years versus ≥17 years; dichotomized in relation to mean age at surgery), body mass index category (underweight or healthy weight versus overweight or obese), grade (I or II versus III or IV), procedure (procedure with skin removal versus procedure without skin removal), and complication status (at least one complication versus no complication). Pearson chi-square or Fisher exact tests were used to compare complication status by demographics, as appropriate. A

**Table 1. Postoperative Complication Definitions**

Minor severity	
Early	
	Surgical-site infection
	Resulting in oral administration of antibiotics
	Wound dehiscence
	Open wound at the incision point that necessitates local wound care for <4 wk
	Seroma/hematoma
	Requiring aspiration in clinic
Late	
	Sensory changes
	Pigmentation changes of nipple-areola complex
	Residual tissue*
	Asymmetry†
	Nipple inversion
	Contour irregularities*
	Scar hypertrophy†
	Keloid†
Major severity	
Early	
	Surgical-site infection
	Resulting in admission for intravenous administration of antibiotics
	Wound dehiscence
	Open wound at the incision point that necessitates ≥4 weeks of dressing changes or reoperation
	Seroma/hematoma
	Requiring return to operating room for evacuation
	Deep vein thrombosis
	Pulmonary embolism
	Delayed wound healing

\*Patient-initiated concern.

†Requiring intervention.

logistic regression model was used to analyze the effect of body mass index category and procedure type on complication status. A paired samples *t* test was used to compare within-subject preoperative to postoperative survey score changes. Independent samples *t* tests were used to compare postoperative survey scores by age, procedure, and complication status. A linear regression model was fit to analyze the effect of grade and body mass index category on postoperative survey scores. A 20 percent missing data threshold was used for all analyses, and results were considered statistically significant for values of  $p < 0.05$ .

## RESULTS

### Patient Demographics and Operative Data

We enrolled 145 patients (mean age at surgery,  $16.8 \pm 2.0$  years) (Table 2). In total, 76 patients were aged younger than 17 years and 69 patients were older than 17 years; with regard to the prospective limb, there were 24 patients younger than 17 years and 27 patients older than 17 years. Most patients identified as white, non-Hispanic (54.5 percent) and were obese (52.1 percent). A total of 270

breasts were repaired surgically, with 13.8 percent of patients requiring unilateral correction. Two-thirds of breasts were classified as grade III or IV ( $n = 180$ ) (Table 3). Skin-sparing mastectomy was used for 60.7 percent of breasts, whereas mastectomy with skin removal was used for 35.6 percent of breasts. Mastectomy with free nipple grafting was performed on 3 percent of breasts, and only 0.7 percent were treated with liposuction alone.

### Surgical Outcomes

Early complications occurred in approximately 28 of 270 breasts (10 percent) (Table 4). Hematomas were the most common complication, occurring in 21 breasts (7.8 percent). The majority of hematomas were minor ( $n = 18$  of 21), requiring a single clinic aspiration. Minor surgical-site infections occurred in six breasts (2.2 percent) and were managed with oral antibiotics. Seromas [ $n = 5$  (1.9 percent)] and delayed wound healing [ $n = 4$  (1.5 percent)] were relatively rare. Wound dehiscence, deep vein thrombosis, and pulmonary emboli were not observed.

Approximately 129 of 145 patients (239 breasts) (89 percent) were available for evaluation outside the early postoperative period, with a median follow-up time of 8.6 months (minimum, 0.2 months; maximum, 58.6 months; interquartile range, 22.0 months). Within this subset, at least one complication occurred in 82 of 239 breasts (34.3), with residual tissue [ $n = 30$  (12.6 percent)] and contour irregularities [ $n = 22$  (9.2 percent)] being most common (Table 5). Inverted nipples occurred in a smaller percentage of breasts (4.6 percent), whereas hypertrophic scars (2.5 percent) and keloids were relatively rare (1.3 percent).

### Effect of Demographics, Severity, and Procedure Type on Complication Status

Developing any, early, or late complications did not vary by age or grade ( $p > 0.05$ , all). When

**Table 2. Patient Demographics and Diagnoses**

Characteristic	Value (%)
No. of patients	145
Mean age at surgery $\pm$ SD, yr	$16.8 \pm 2.0$
Diagnosis	
Bilateral gynecomastia	125 (86.2)
Unilateral gynecomastia	20 (13.8)
BMI, kg/m <sup>2</sup>	
Median	27.5
IQR	7.9
Range	16.4–54.8
BMI percentile	
Median	95.5
IQR	11.0
Range	1.0–99.0
BMI category	
Underweight	2 (1.4)
Healthy	28 (19.7)
Overweight	38 (26.8)
Obese	74 (52.1)
BMI, kg/m <sup>2</sup>	
Median	32.6
IQR	5.4
Range	24.3–54.8
BMI percentile	
Median	99.0
IQR	2.0
Range	95.0–99.0
Ethnicity	
White, non-Hispanic	79 (54.5)
Unknown	26 (17.9)
Black or African American	23 (15.9)
Hispanic	7 (4.8)
Other	7 (4.8)
American Indian or Alaska Native	2 (1.4)
Asian	1 (0.7)

BMI, body mass index; IQR, interquartile range.

**Table 3. Distributions of Gynecomastia Grades and Surgical Techniques**

Characteristic	Value (%)
No. of breasts	270
Grade	
I	19 (7.0)
II	71 (26.3)
III	114 (42.2)
IV	66 (24.4)
Procedure	
Mastectomy without skin removal	164 (60.7)
Mastectomy with skin removal	96 (35.6)
Mastectomy with free nipple graft	8 (3.0)
Liposuction only	2 (0.7)



**Table 4. Early Postoperative Complications**

Characteristic	Value (%)
No. of breasts	270
Hematoma	21 (7.8)
Minor*	18 (6.7)
Major†	3 (1.1)
Minor surgical-site infection‡	6 (2.2)
Seroma*	5 (1.9)
Delayed wound healing	4 (1.5)

\*Aspirated in clinic.

†Operative evacuation.

‡Outpatient oral antibiotics.

controlling for procedure type, complications did not vary by body mass index category ( $p > 0.05$ , all). However, after accounting for body mass index category, breasts that underwent skin removal were 2.5 times more likely to develop at least one early complication compared to those that underwent skin-sparing procedures (OR, 2.52; 95 percent CI, 1.08 to 5.85;  $p = 0.03$ ). (See **Table, Supplemental Digital Content 1**, which shows results of a logistic regression model with early complications as the outcome variable, and body mass index category and procedure type as the explanatory variables, <http://links.lww.com/PRS/F46>.)

### Impact of Surgical Outcomes on Changes in Health-Related Quality of Life

Fifty-one prospectively enrolled patients completed preoperative and postoperative health-related quality-of-life surveys with a median follow-up time of 33.3 months (minimum, 6.1 months; maximum, 130.4 months; interquartile range, 41.0 months). Early surgical outcome data were available for all 51 patients, and late outcome data were available for 48 of 51 patients (94.1 percent).

Overall, patients experienced significant postoperative improvements on the Rosenberg Self-Esteem Scale and in seven of eight Short-Form Health Survey domains (Physical Functioning, Role-Physical, Bodily Pain, Vitality, Social Functioning, Role-Emotional, and Mental Health;  $p < 0.05$ , all) (**Table 6**). Improvements in the General Health domain approached significance

**Table 6. Mean Preoperative to Postoperative Health-Related Quality-of-Life Score Difference**

	Mean Preoperative to Postoperative Difference (95% CI)*	$p^{\dagger}$
SF-36 domains		
Physical Functioning	9.9 (3.3–16.5)	0.004
Role-Physical	7.6 (0.3–14.9)	0.04
Bodily Pain	8.4 (3.9–12.9)	0.001
General Health	5.7 (–0.3 to 11.7)	0.06
Vitality	6.9 (2.2–11.6)	0.005
Social Functioning	16.3 (7.0–25.5)	0.001
Role-Emotional	11.5 (4.4–18.6)	0.002
Mental Health	9.4 (1.8–17.0)	0.02
RSES	2.6 (1.0–4.3)	0.003
EAT-26	–0.9 (–2.9 to 1.1)	0.37

SF-36, 36-Item Short-Form Health Survey (Version 2); RSES, Rosenberg Self-Esteem Scale; EAT-26, Eating Attitudes Test.

\*Positive values reflect preoperative to postoperative improvements in scores for the SF-36 and RSES. A negative value reflects preoperative to postoperative improvement for the EAT-26.

†Paired samples  $t$  test.

( $p = 0.06$ ), whereas Eating Attitudes Test scores remained stable ( $p = 0.37$ ).

The Rosenberg Self-Esteem Scale, Short-Form Health Survey, and Eating Attitudes Test postoperative survey scores did not vary by grade or procedure type ( $p > 0.05$ , all), and largely did not vary by age, complication status, or body mass index category ( $p > 0.05$ , all). However, patients younger than 17 years at the time of surgery ( $n = 24$ ) had significantly higher postoperative Short Form-36 Vitality and Mental Health domain scores compared to older patients ( $n = 27$ ) (**Table 7**) ( $p < 0.05$ , both). Rosenberg scale scores and seven of eight Short Form-36 domain scores were similar between patients who experienced at least one complication and patients with no complication ( $p > 0.05$ , all) (**Table 8**). Conversely, patients who experienced at least one complication scored significantly lower in the Role-Emotional domain postoperatively compared to those without a complication ( $p = 0.01$ ). In addition, overweight or obese patients had significantly worse postoperative Eating Attitudes Test scores compared to underweight or healthy weight patients ( $p = 0.003$ ). However, mean scores for both groups (9.1 and 3.5, respectively) were considerably below the threshold of 20 that would indicate disordered eating behaviors.

## DISCUSSION

Gynecomastia is common in adolescent male subjects, and causes significant health-related quality-of-life and psychosocial deficits.<sup>1–8,14,19–23,25,29,30</sup> Despite studies reporting health-related quality-of-life improvements in adolescents after

**Table 5. Late Postoperative Complications**

Characteristic	Value (%)
No. of breasts	239
Residual tissue	30 (12.6)
Contour irregularities	22 (9.2)
Sensory changes	15 (6.3)
Nipple inversion	11 (4.6)
Scar hypertrophy	6 (2.5)
Keloid	3 (1.3)

**Table 7. Mean Postoperative Health-Related Quality-of-Life Scores by Age Group**

	Patients Aged <17 Yr at the Time of Surgery	Patients Aged ≥17 Yr at the Time of Surgery	<i>p</i>	Mean Difference* (95% CI)
No.	24	27		
SF-36 domains				
Physical Functioning	94.1 ± 20.4	93.0 ± 16.6	0.83	1.1 (−9.5 to 11.8)
Role-Physical	89.8 ± 20.1	89.4 ± 23.0	0.94	0.5 (−11.7 to 12.7)
Bodily Pain	82.9 ± 10.0	79.3 ± 18.8	0.40	3.7 (−5.0 to 12.3)
General Health	77.8 ± 17.1	74.8 ± 23.5	0.61	3.0 (−8.9 to 15.0)
Vitality	59.6 ± 13.3	48.5 ± 19.6	0.02†	11.1 (1.5–20.7)
Social Functioning	91.7 ± 15.9	77.3 ± 33.1	0.05	14.4 (−0.1 to 28.8)
Role-Emotional	89.6 ± 15.2	85.9 ± 22.8	0.50	3.7 (−7.3 to 14.7)
Mental Health	81.7 ± 15.4	66.5 ± 25.4	0.01†	15.3 (3.5–27.0)
RSES	34.0 ± 5.6	31.3 ± 5.6	0.09	2.7 (−0.4 to 5.9)
EAT-26	7.1 ± 6.3	8.4 ± 6.3	0.45	−1.4 (−5.1 to 2.3)

SF-36, 36-Item Short-Form Health Survey (Version 2); RSES, Rosenberg Self-Esteem Scale; EAT-26, Eating Attitudes Test.

\*Mean score difference between groups younger than 17 years at the time of surgery and 17 years or older at the time of surgery. A positive value illustrates a higher mean survey score for patients younger than 17 years at the time of surgery compared to patients 17 years or older at the time of surgery.

†Statistically significant.

gynecomastia repair, no data exist regarding the impact of complications on patient-reported outcomes following gynecomastia surgery.<sup>21</sup> Using validated surveys and clinical outcome data, the present study demonstrates that adolescents experience significant postoperative health-related quality-of-life gains following gynecomastia repair, largely regardless of grade, procedure type, or complication status.

### Surgical Approach

Rather than a single technique, clinical features (e.g., body mass index, grade, skin excess and quality, and patient age), patient and parental concerns (e.g., visible scarring or altered nipple sensation), and surgeon preference are used to select the surgical approach. In addition, the pros and cons of appropriate techniques are discussed with patients and families preoperatively. Similar to this study, most adolescent studies report patients undergoing mastectomy with or without liposuction for gynecomastia correction, with skin excision assessed on

an individual basis.<sup>2,21,22,27–31</sup> However, discussion of surgical techniques used in this study is to provide context for outcomes, rather than to speculate on which approach is optimal.

In the current study, the majority of patients were overweight or obese and presented with high-grade gynecomastia (grades III and IV). Although most adolescent patients have good skin quality and postoperative skin contraction, marked tissue or striae in high-grade, obese patients may prompt surgeons to consider procedures that include skin resection. In borderline cases, patients and parents may elect to avoid longer incisions and more visible scarring, and instead observe the skin postoperatively and excise excess in the office to improve contour. Alternatively, if skin excision is included, either a pedicle or a free-nipple graft will be necessary. In addition to more visible scarring, some patients may “feel” the pedicle postoperatively, and request removal of this tissue. This is also typically done in the office under local anesthesia.

**Table 8. Mean Postoperative Health-Related Quality-of-Life Scores by Complication Status**

	No Complication Group	Complication Group	<i>p</i>	Mean Difference* (95% CI)
SF-36 domains				
Physical Functioning	91.9 ± 24.0	95.0 ± 10.2	0.55	3.1 (−7.4 to 13.7)
Role-Physical	90.6 ± 24.5	88.7 ± 18.9	0.75	−2.0 (−14.2 to 10.3)
Bodily Pain	83.3 ± 14.9	78.9 ± 15.5	0.30	−4.4 (−13.0 to 4.2)
General Health	79.6 ± 16.8	73.3 ± 23.4	0.29	−6.3 (−18.1 to 5.6)
Vitality	55.2 ± 17.4	52.6 ± 18.1	0.61	−2.6 (−12.8 to 7.5)
Social Functioning	88.5 ± 26.0	80.1 ± 28.0	0.27	−8.4 (−23.7 to 6.8)
Role-Emotional	94.9 ± 10.9	81.5 ± 22.9	0.01†	−13.4 (−23.5 to −3.4)
Mental Health	78.0 ± 20.2	69.6 ± 24.1	0.19	−8.4 (−21.2 to 4.3)
RSES	33.2 ± 5.6	32.1 ± 5.8	0.50	−1.1 (−4.3 to 2.1)
EAT-26	6.0 ± 5.8	9.3 ± 6.4	0.06	3.4 (−0.2 to 6.9)

SF-36, 36-Item Short-Form Health Survey (Version 2); RSES, Rosenberg Self-Esteem Scale; EAT-26, Eating Attitudes Test.

\*Mean score difference between complication and no complication groups. A negative value illustrates a lower mean survey score for patients with at least one complication compared to patients without a complication.

†Statistically significant.

## Complications

Complications, regardless of technique, are common following adolescent gynecomastia repair.<sup>2,6,22,25,27–31</sup> As a whole, our total complication rate of 36.3 percent is slightly higher than comparable studies (range, 3.9 to 33.3 percent).<sup>22,25,28,29</sup> However, the likelihood of developing at least one complication did not vary by body mass index category, grade, or age. This absence of variation aligns with a series of adolescent, young adult, and adult studies.<sup>22,25,29,39–41</sup>

In addition, 10 percent of breasts experienced at least one early complication, but major complications, such as deep vein thrombosis, pulmonary embolism, and major infection warranting intravenous antibiotics, were not observed. Hematoma formation, which occurred in 7.8 percent of breasts, was the most common early complication, falling within the range of current adolescent studies (2.8 to 14.5 percent).<sup>22,27–29</sup> In addition, of those patients available outside the early postoperative period, 34.3 percent of breasts had at least one late complication. Residual tissue and contour irregularities were the most common late complications, occurring in 12.6 and 9.2 percent of breasts, respectively, considerably higher than other adolescent studies.<sup>22,27,29</sup> Of note, our study had a median clinical follow-up time of 8.6 months, whereas analogous adolescent studies reported mean and median follow-up times of 18.6 and 36 months, respectively.<sup>27,29</sup> Longer follow-up times in this population can be considerable, as growth and scar maturation may positively impact contour irregularities and residual tissue following gynecomastia correction.

Although this study was not designed to directly compare complication rates between techniques, it was found that breasts undergoing skin removal procedures were 2.5 times more likely to develop an early complication as compared to those undergoing skin-sparing procedures. These data are not available for adolescents, and adult studies have shown varied results on the impact of skin removal in gynecomastia procedures.<sup>9,41–43</sup> This suggests that more research is needed to fully comprehend the impact of skin removal procedures on postoperative complications following gynecomastia repair.

## Changes in Health-Related Quality of Life

Patients in our series demonstrated significant improvements in self-esteem and in seven of eight health-related quality-of-life domains following gynecomastia surgery, aligning with analogous

studies in adults and adolescents.<sup>9–11,15,17,18,21,44</sup>

Similar to prior work by this group, younger patients in this series experienced greater health-related quality-of-life gains than older patients.<sup>21</sup> However, the present study also demonstrated significant gains in self-esteem and in three of the four Short Form-36 mental health domains (Vitality, Role-Emotional, and Mental Health). A reason for this discrepancy may be the difference in follow-up times between the two studies, with median survey follow-up of 18.1 and 33.3 months, in the prior and current studies, respectively. These data may reflect the additional time required to fully realize the psychological benefits of gynecomastia surgery.

Complication status did not impact self-esteem, or most health-related quality-of-life outcomes following surgery. Only gains in the Role-Emotional domain within the Short Form-36 were diminished in patients with at least one complication. Although no comparable studies exist for young men, similar observations have also been reported in adolescent female subjects, where self-esteem and the majority of postoperative health-related quality-of-life scores did not vary by complication status after reduction mammoplasty for macromastia.<sup>45</sup> These data suggest that adolescents, while still maturing, are appropriately equipped to handle the complications associated with gynecomastia repair.

## Limitations

Patients were recruited from a single, tertiary care facility, and results may not be generalizable. Likewise, the median clinical follow-up time was relatively short with substantial patient dropout. In addition, patients with minor gynecomastia treated with excision under local anesthesia only were excluded. Although this may have exaggerated complication rates in this series, it created a more rigorous test to determine whether higher complication rates impacted patient-reported outcomes. Because of the relatively small number of health-related quality-of-life surveys, we were unable to run a multivariate analysis assessing the association between complications and quality of life, controlling for surgical technique. In addition, analyses stratified by early and late complications may be underpowered.

Although surgical techniques were discussed, the purpose of this study was not to compare techniques for gynecomastia. Because of the variety of techniques available for surgical treatment of gynecomastia, health-related quality-of-life outcomes may not be equivalent across all surgical approaches.



Although the Short Form-36, Rosenberg Self-Esteem Scale, and Eating Attitudes Test surveys have been validated in various populations, and have been used in previous adolescent breast patient studies to examine health-related quality of life, self-esteem, and eating behaviors, respectively, these surveys have not been validated specifically for patients with gynecomastia.<sup>20,21,45</sup> Similarly, the minimal clinically important difference has not been derived for adolescent gynecomastia; thus, no direct comparisons to an established minimal clinically important difference could be made.

## CONCLUSIONS

Adolescent patients experienced significant health-related quality-of-life and self-esteem gains following gynecomastia surgical repair. Although postoperative complications are common following gynecomastia correction, complication status has limited impact on postoperative health-related quality of life or self-esteem. Although additional studies are needed, current evidence suggests that the potential for complications should not limit treatment recommendations in younger patients with gynecomastia. To the contrary, intervening in younger patients (younger than 17 years) may lead to better postoperative health-related quality-of-life outcomes, and may mitigate some of the long-term psychological effects of gynecomastia.<sup>15,21</sup>

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