

Reduction Mammoplasty in Younger Patients: An Evidence-Based Approach to Treatment

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Macromastia is a common condition that can lead to physical pain, emotional burden, and behavioral impairment, with significant decrements in quality of life. Reduction mammoplasty offers the only effective treatment of symptomatic macromastia, and patients experience significant improvements in their physical and psychosocial health through surgical correction. Although symptoms typically arise during adolescence, most women seeking surgical intervention do not undergo reduction mammoplasty until their fifth decade of life. Providers often delay surgery due to speculative concerns about emotional immaturity, post-operative breast regrowth, and future lactation performance.

The strict guidelines related to age and body mass index imposed by insurance companies further restrict the options available to younger patients with macromastia. This review offers an evidence-based approach to treating macromastia in younger patients. After more than 15 years of treatment and research centered on adolescents and young adults with macromastia led by the senior author (B.I.L.), a pediatric plastic surgeon, we have found that reduction mammoplasty is a safe and effective treatment option for this patient population. It is our hope that our work will enable care providers to make data-supported decisions when treating younger patients with symptomatic macromastia.

Macromastia is a common condition marked by unilateral or bilateral breast *hypertrophy* (i.e., enlargement) and is accompanied by physical and psychosocial health-related quality of life (HRQoL) deficits that have been well documented in the literature (Atterhem et al., 1998; Behmand et al., 2000; Blomqvist & Brandberg, 2004; Blomqvist et al., 2000; Brühlmann &

Tschopp, 1998; Cerrato et al., 2012; Chadbourne et al., 2001; Chao et al., 2002; Collins et al., 2002; Corriveau & Jacobs, 1990; Crerand & Magee, 2013; Eggert et al., 2009; Evans & Ryan, 1994; Freire et al., 2007; Gonzalez et al., 1993; Hermans et al., 2005; Iwuagwu et al., 2006; Kerrigan et al., 2001; Koltz et al., 2011; Lee et al., 2003; McMahan et al., 1995; Mello et al., 2010; Miller et al., 2005; Nguyen et al., 2013; O'Blenes et al., 2006; Sabino Neto et al., 2008; Shakespeare & Cole, 1997; Sigurdson et al., 2007; Singh & Losken, 2012; Spector & Karp, 2007; Thoma et al., 2007; Xue et al., 2013). Specifically, macromastia often results in substantial inframammary *intertrigo* (i.e., skin inflammation) and musculoskeletal pain in the neck and back that can limit physical activity and preclude participation in sports (Cerrato et al., 2012; Chao et al., 2002; Freire et al., 2007; Hermans et al., 2005; Kerrigan et al., 2001; Singh & Losken, 2012; Spector & Karp, 2007). In addition, clothing options, including bras, dresses, or swimwear, may be limited or extremely expensive (Cerrato et al., 2012). There is also a considerable negative impact to psychosocial well-being that is magnified during adolescence, including poor self-esteem and self-image, embarrassment from peers, and potential increased risk of eating disorders (Lee et al., 2003; Losee et al., 1997, 2004; McMahan et al., 1995; Sigurdson et al., 2007).

Reduction mammoplasty (i.e., breast reduction) is the documented surgical treatment of macromastia and perennially one of the most popular operations performed

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by plastic surgeons. Extensive research has detailed the physical, emotional, and psychosocial gains following reduction mammoplasty in adult patients, thereby highlighting the effectiveness of this procedure as a treatment for macromastia (Behmand et al., 2000; Blomqvist & Brandberg, 2004; Blomqvist et al., 2000; Boschert et al., 1996; Brühlmann & Tschopp, 1998; Chadbourne et al., 2001; Chao et al., 2002; Collins et al., 2002; Creland & Magee, 2013; Eggert et al., 2009; Evans & Ryan, 1994; Freire et al., 2007; Glatt et al., 1999; Gonzalez et al., 1993; Hermans et al., 2005; Iwuagwu et al., 2006; Losee et al., 2004; Mello et al., 2010; Miller et al., 2005; Saariniemi et al., 2008, 2009; Sabino Neto et al., 2008; Singh & Losken, 2012; Spector & Karp, 2007; Thoma et al., 2007). Despite the challenges macromastia poses during adolescence, most women do not undergo reduction mammoplasty until their fifth decade of life (Corriveau & Jacobs, 1990; Nuzzi et al., 2017). Providers often delay surgical intervention due to a myriad of factors, including a lack of appreciation for the negative impact of macromastia on HRQoL, a belief that weight loss substitutes for surgery, potential lactation impairments, and unsubstantiated concerns for psychological immaturity and its impact on the ability to cope with potential complications or scarring (Evans & Ryan, 1994; Lee et al., 2003; Nuzzi et al., 2020; Xue et al., 2013).

Until recently, very little research centered on younger patients with macromastia was available to guide clinical care. Our group has dedicated the past 15 years toward measuring the impact and outcomes of macromastia and reduction mammoplasty in the adolescent population. We have demonstrated that adolescents who undergo reduction mammoplasty experience the same postoperative improvements in breast-related symptoms, self-esteem, and HRQoL as adults (Cerrato et al., 2012; Nuzzi et al., 2017, 2020). Furthermore, these gains are largely independent of age or body mass index (BMI) category and still experienced among patients with postoperative complications (Nuzzi et al., 2019). The aim of this review is to summarize our overall clinical approach to treating macromastia in this younger population of patients in an evidence-based format.

APPROACH

In 2006, a multidisciplinary Adolescent Breast Clinic was established among the Departments of Plastic and Oral Surgery, Adolescent Medicine, and Pediatric Surgery at Boston Children's Hospital. The primary goal of this collaboration was to establish comprehensive coordinated care for patients with breast concerns. Within this specialized clinic, we also developed a prospective longitudinal study, approved by our institutional review board (Protocol No. X08-10-0492), to accrue outcome data to establish the impact of macromastia and collectively examine the

subsequent effects of surgical treatment in this age group to produce data-supported treatments. Patients were eligible for this study if they were diagnosed with macromastia, were between the ages of 12 and 21 years, and had not undergone previous surgery for macromastia. An age-matched cohort of unaffected female control patients was concurrently recruited to provide a meaningful comparison with our study participants as appropriate. Patients qualified for the control cohort if they were in a general state of good health and did not have a history of a breast/chest disorder or condition, notable medical or surgical history, an eating disorder diagnosis, or other psychosocial concerns. Written informed consent from all patients and parents/guardians was obtained during initial consultation for prospective enrollment.

Throughout this longitudinal study, our team utilized four standardized surveys to establish the baseline physical and HRQoL impacts that macromastia has on adolescents and young women, and how these outcomes improve over time following reduction mammoplasty. These surveys include the following: (1) 36-item Short Form Health Survey (SF-36), which utilizes eight different domains to establish HRQoL; (2) Rosenberg Self-Esteem Scale (RSES), which examines levels of self-esteem; (3) Breast-Related Symptoms Questionnaire (BRSQ), which assesses physical breast-related symptoms; and (4) Eating-Attitudes Test-26 (EAT-26), which evaluates general eating habits and behaviors (Garner et al., 1982; Kerrigan et al., 2001; Rosenberg, 1965; Ware, 2000). These surveys, along with physical examinations performed by the senior plastic surgeon, have enabled us to develop a more comprehensive view of the adolescent and young adult patient's experience with macromastia.

PATIENT PRESENTATION AND IMPACT

When patients with macromastia come to our clinic for evaluation, they are, on average, approximately 17 years old. Significantly more are overweight or obese than control patients despite similarities in age (Cerrato et al., 2012; Nuzzi et al., 2017). In fact, the distribution of BMI category has remained fairly constant among our cohort of patients with macromastia over time; one third of patients are typically categorized as healthy weight, one third as overweight, and one third as obese, based on the Centers for Disease Control and Prevention (CDC) criteria (CDC, 2022a, 2022b; Cerrato et al., 2012; Nuzzi et al., 2017, 2019). In addition, the mean ages of *thelarche* (i.e., breast enlargement) and *menarche* (i.e., first menstruation) for patients with macromastia are approximately 11 and 12 years, respectively (Nuzzi et al., 2020).

The symptom profile of adolescent and young adult patients with symptomatic macromastia is highly consistent and resembles that of older patients. Nearly all patients present with at least moderate physical symptoms

such as neck, back, and shoulder pain. Other physical effects, including recurrent intertriginous irritation or soft tissue infections beneath and between the breasts, are common and well known. Of particular note, we have found that these symptoms are significantly more severe in adolescents with macromastia than in controls of a similar age, even after adjusting for BMI category (Cerrato et al., 2012).

Although physical symptoms of macromastia have become more well-established in the adolescent population over the years, the psychosocial impact of macromastia on younger patients is often underappreciated. Given this, a major focus of our longitudinal studies has been to establish the psychosocial deficits that arise in adolescents and young adults impacted by this disorder. Patients have reported social difficulties manifesting in time and money spent finding bras and clothing that fits appropriately. In addition, ongoing participation in a sport or activity that is central to their lives is difficult or impossible. These social obstacles often exacerbate the psychosocial health decrements seen in adolescents with macromastia. In one of our earlier studies of 96 adolescents with macromastia (and 103 controls), we found that the macromastia cohort had significantly lower HRQoL (in seven of eight SF-36 domains) and self-esteem than controls, after controlling for BMI category (Cerrato et al., 2012). Similar to the reported physical symptoms, this illuminates how BMI category is not the guiding predictor of these psychosocial deficits.

Although all young patients with symptomatic macromastia may not be appropriate candidates for surgery when they present, well-intentioned clinicians who withhold surgery solely based on age or BMI should be fully aware of the negative impact that nontreatment or undertreatment can elicit. In many cases, nonsurgical treatment options have been presented to younger patients, due in large part to hesitancy to operate on this group and/or insurance requirements. Common alternative treatment options recommended to patients include supportive bras, weight loss, physical therapy, and oral analgesics. Insurers often require patients to utilize a variety of these treatment options for periods of 6 months or more before considering approval for surgical treatment (Collins et al., 2002). One study of 179 adults with macromastia presenting for surgery demonstrated that these options were insufficient in offering long-term relief of their symptoms; however, surgical treatment alone alleviated the macromastia symptoms (Collins et al., 2002).

REDUCTION MAMMAPLASTY

Preoperative Care

During initial consultation, clinical staff perform a detailed history and physical examination to assess breast symptoms, pubertal/gynecological history (including

thelarche and menarche), mental health status, and relevant medical and surgical history. Patients are advised with respect to managing baseline symptoms, as well as expected outcomes, benefits, and potential complications associated with reduction mammoplasty.

If the patient and parents are interested in pursuing surgery, a preauthorization letter that includes standardized photographs is sent on their behalf to their insurer. A decision regarding coverage typically requires that the modified *Schnur criteria* (Schnur sliding scale) are met. In general, this involves comparing the predicted surgical mass to be removed in grams to the patient's calculated body surface area (BSA) (Schnur, 1999; Schnur et al., 1991). If the resected mass exceeds the 22nd percentile for a given BSA, reduction mammoplasty is usually considered medically necessary (Nuzzi et al., 2017; Schnur, 1999).

Timing and Technique

The timing of surgery in younger patients has been and in many instances is still dictated by insurance requirements such as an age older than 18 years or prior participation in months of physical therapy. Data to support these criteria are lacking. Moreover, surgeon hesitancy to offer reduction mammoplasty to this population still exists mainly over concerns regarding postoperative breast regrowth, patient maturity in response to complications, and future lactation ability.

Using a cohort of 481 patients with macromastia averaging 18 years of age at surgery, our team analyzed postoperative regrowth, years postmenarche, and BMI category to derive a model to determine when reduction mammoplasty can be performed with minimal risk for postoperative breast development. For healthy and overweight patients, breast growth had stabilized 3 years postmenarche, whereas obese patients had a more rapid onset of breast growth that lasted up to 9 years postmenarche. Overall, we have observed a low occurrence of postoperative breast growth (6%) in our sample, with half of those cases attributable to weight gain as opposed to glandular regrowth and cause of regrowth being independent of BMI category (Nuzzi et al., 2020). Even when breast growth does occur after surgery, most patients remain asymptomatic and still experience equivalent gains in HRQoL (Nuzzi et al., 2019). We have concluded that age alone is an arbitrary criterion for surgery, and the risks of regrowth have been overstated, historically. Furthermore, in severe cases where our patients are highly symptomatic, consideration may be given to surgery within the 3-year window following menarche.

With respect to surgical technique, successful reduction mammoplasty has been performed using a variety of incision types and pedicle orientations. The *pedicle* simply refers to the mound of glandular and subcutaneous tissue that supports the nipple-areolar complex (NAC). The pedicle can be oriented inferiorly, superiorly,

medially, or in intermediate positions. *Orientation* refers to the direction in which the majority of the blood supply is expected to originate. Although the senior author (B.I.L.) typically performs the inferior pedicle, using the Wise pattern approach, all established techniques have been demonstrated to be largely effective and equivalent (Ogunleye et al., 2017). About 30 minutes prior to completion of the procedure, our institution's specified maximum safe volume of 0.25% bupivacaine hydrochloride with epinephrine is infiltrated subfascially (up to 150 mg if patient weight is ≥ 60 kg or 1 ml/kg of weight if patient weight is < 60 kg), and a dose of intravenous acetaminophen and ketorolac is given unless medically contraindicated. Although some studies have suggested an elevated risk of hematoma formation with ketorolac in patients undergoing reduction mammoplasty, our data do not demonstrate this association (Firriolo et al., 2018).

Postoperative Care

The procedure typically requires a 2- to 3-hr general anesthetic and is routinely performed as an outpatient procedure. Overnight stays may occur in cases where patients require pain optimization, have a medical condition necessitating treatment, and live far away, or if the patient or parent has a desire for a longer period of observation. The patient is discharged home in a surgical support bra that the nurses place on the patient while in the operating room. Pain control is usually achieved with consistent dosing of acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs) for a 3- to 5-day period. Four doses of opioid analgesic are also provided for breakthrough pain or to help with sleep during the first night or two following the procedure.

Most patients return to school or a light job 1 week following surgery, around the time of their first postoperative visit. We usually ask patients to keep their surgical bra in place until the first visit to help manage the patients' reaction to their operation. Activity restrictions are in place for 6 weeks, during which soft sports bras with no underwire are used for support. Customarily, patients are seen for the following postoperative appointments to examine their progression of healing: 2–3 weeks after the first visit, then 3–4 months later, and 12 months postoperatively. Thereafter, patients are seen annually.

Postoperative Patient-Reported Outcomes

Preoperative HRQoL deficits and physical impairments in patients with macromastia are numerous and well-documented, but postoperative HRQoL outcomes in younger patients have been lacking. Our group observed significant postoperative improvements in HRQoL, self-esteem, breast-related symptoms, and eating attitudes and behaviors after correction with reduction mammoplasty, as evidenced by a study of 102 patients with macromastia

and 84 age-matched female controls. Survey scores were comparable (and sometimes superior) with those of controls 6 months postoperatively, a sustained effect seen in results from 1-, 3-, and 5-year follow-up time points (Nuzzi et al., 2017).

We also examined the effects of age and BMI on postoperative outcomes after reduction mammoplasty. When the macromastia cohort was divided into younger (< 18 years) and older patients (≥ 18 years), both subgroups experienced significant score improvements in all measures postoperatively, except for the mental health SF-36 domain in younger patients. In addition, stratification of the macromastia cohort by BMI revealed that both healthy and overweight or obese patients benefitted significantly from surgical correction. In fact, obese patients derived largely similar gains in HRQoL as compared with normal or overweight patients, with only the mental and general health domains of the SF-36 remaining stable postoperatively (Nuzzi et al., 2017). These findings suggest that strict age and BMI limits for surgery are generally arbitrary.

Postoperative Complications

There is ample research documenting the complications associated with reduction mammoplasty in adults, which are experienced by an estimated 14%–53% of patients (Cunningham et al., 2005; Roehl et al., 2008; Shah et al., 2011; Srinivasaiah et al., 2014). Common complications include scarring, wound dehiscence, infection, hematoma/seroma, and altered breast/nipple sensation. There is a paucity of similar longitudinal investigation of adolescent and young adult patients. One study from our group examined more than 500 patients over a 7-year postoperative time period to determine the short- and long-term complication profiles for this subset of patients. In addition, HRQoL outcomes were compared between patients with and without complications to determine whether negative outcomes in this group diminished physical, emotional, and/or psychosocial gains (Nuzzi et al., 2019).

In this study, approximately one third of patients experienced at least one surgical complication, similar to the rate experienced by adult patients (Cunningham et al., 2005; Roehl et al., 2008; Shah et al., 2011; Srinivasaiah et al., 2014). Early complications were minor and independent of age, BMI category, and resection mass; less than 3% of patients experienced hematoma/seroma, minor infection requiring oral antibiotics, or delayed wound healing requiring greater than 6 weeks of dressing changes. Furthermore, no major complications were seen in our sample, such as deep vein thrombosis, pulmonary embolism, or major infection requiring intravenous antibiotics (Nuzzi et al., 2019).

Late complications persisting beyond the first postoperative year included partial nipple or breast *hypoesthesia* (i.e., reduced sensation in response to a stimulus) in less

than 9% of patients, and no subjects reported complete loss of nipple sensation. Hypertrophic scars or patient-reported scar concerns occurred in 20% of patients presenting for follow-up beyond 1 year. Persistent breast or nipple pain, inverted nipples, *bottoming out* (nipple-to-inframammary fold distance lengthening), and altered nipple pigmentation occurred in less than 3% of the sample. Postoperative breast growth was experienced by 12 patients (5.3%), of which three patients underwent a second reduction mammoplasty (Nuzzi et al., 2019).

Complication Impact on Patient-Reported Outcomes

We used the postoperative complication data reported to investigate the potential impact of complications on postoperative HRQoL gains. Of the 512 patients in the complication study cohort earlier, 207 participants completed the four pre- and postoperative quality-of-life surveys utilized across our consistent research design. Both patients with and without complications experienced significant score improvements in the SF-36, RSES, and BRSQ. Although the EAT-26 magnitude of change approached significance, we noted that both pre- and postoperative mean scores remained below the clinical threshold for disordered eating attitudes and behaviors. Patients with early complications demonstrated significant postoperative score improvements in all domains, and those with late complications improved in most measures (Nuzzi et al., 2019). In sum, the postoperative complication rate was consistent with that of older patients undergoing reduction mammoplasty. Within our large cohort of younger patients, those with surgical complications still largely shared in the improvements to their physical and psychosocial well-being experienced by those unaffected by complications. These observations suggest a favorable risk-to-reward ratio in younger patients with reduction mammoplasty. In addition, younger patients seem equally able to tolerate postoperative complications as compared with older women.

CONCLUSIONS

Reduction mammoplasty remains one of the most common plastic surgical procedures performed in the United States, with extensive and well-documented physical and psychosocial gains experienced by patients undergoing the procedure (Behmand et al., 2000; Blomqvist & Brandberg, 2004; Blomqvist et al., 2000; Boschert et al., 1996; Brühlmann & Tschopp, 1998; Chadbourne et al., 2001; Chao et al., 2002; Collins et al., 2002; Crerand & Magee, 2013; Eggert et al., 2009; Evans & Ryan, 1994; Freire et al., 2007; Glatt et al., 1999; Gonzalez et al., 1993; Hermans et al., 2005; Iwuagwu et al., 2006; Losee et al., 2004; Mello et al., 2010; Miller et al., 2005; Saariemi et al., 2008, 2009;

Sabino Neto et al., 2008; Singh & Losken, 2012; Spector & Karp, 2007; Thoma et al., 2007). The average age for patients undergoing breast reduction remains within the fifth or sixth decade of life (Corriveau & Jacobs, 1990; Nuzzi et al., 2017). As such, research has historically centered around the adult patient. It is unclear why younger patients have typically been discouraged or disallowed from surgical treatment when the majority of older patients have manifested symptoms from adolescence onward. More recently, increasing numbers of adolescents and young adults are presenting with symptoms of macromastia and a desire for surgical treatment. A growing body of literature suggests that reduction mammoplasty in this age group is safe and effective. Furthermore, strict age and weight limits appear largely arbitrary and should be replaced by biologically relevant markers such as time since menarche and overall health. Although complications can and do occur in adolescents following reduction mammoplasty, they are typically minor and do not negate the long-term HRQoL benefits that surgical correction of macromastia provides. Although additional long-term outcome data are needed to determine lactation performance in this group, early unpublished data has been quite positive.

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