American Society of Plastic Surgeons Evidence-Based Clinical Practice Guideline Revision: Reduction Mammaplasty

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Summary: A multidisciplinary work group involving stakeholders from various backgrounds and societies convened to revise the guideline for reduction mammaplasty. The goal was to develop evidence-based patient care recommendations using the new American Society of Plastic Surgeons guideline methodology. The work group prioritized reviewing the evidence around the need for surgery as first-line treatment, regardless of resection weight or volume. Other factors evaluated included the need for drains, the need for postoperative oral antibiotics, risk factors that increase complications, a comparison in outcomes between the two most popular techniques (inferior and superomedial), the impact of local anesthetic on narcotic use and other nonnarcotic pain management strategies, the use of epinephrine, and the need for specimen pathology. A systematic literature review was performed, and an established appraisal process was used to rate the quality of relevant scientific research (Grading of Recommendations Assessment, Development and Evaluation methodology). Evidence-based recommendations were made and strength was determined based on the level of evidence and the assessment of benefits and harms. (*Plast. Reconstr. Surg.* 149: 392e, 2022.)

Reduction mammaplasty is a procedure performed for symptomatic breast hypertrophy in more than 100,000 patients per year.[1] There is an extensive body of evidence demonstrating the efficacy of reduction mammaplasty in reducing both physical and psychological symptoms in patients with symptomatic breast hypertrophy.[2–9]

In 2012, the American Society of Plastic Surgeons published the first guideline on

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reduction mammaplasty.[10] The previous guideline recommendations included resection volume, complications, antibiotics, use of drain, liposuction, and symptom reduction. In summary, resection volume was not correlated with symptom relief (grade B evidence); symptoms rather than resection volume were more important when evaluating a patient's candidacy for this procedure. The risk of complications was higher with an increase in resection weights (grade B); but the evidence to suggest that patients with a higher body mass index had increased complications was inconclusive (grade C). The evidence suggested that perioperative antibiotics probably decreased infections (grade C). In patients undergoing a standard reduction mammaplasty without liposuction, the use of drains was not warranted (grade A), but if liposuction was used, surgeon discretion was advocated. The final recommendation was that reduction mammaplasty was effective in reducing symptoms in patients with symptomatic breast hypertrophy (grade A).[10]

The American Society of Plastic Surgeons guideline methodology changed in 2016, resulting in a more robust systematic literature review process. The new methodology can be found at https://plasticsurgerypsf.sharepoint.com/:b:/g/departments/quality/EUIELfeaZddIu9-QsxmxCDsBnR8XEAuDnX_fGWCuF7ogHA?e=5v1C5A.[11] The American Society of Plastic Surgeons Quality and Performance Measurement Committee selected a task force to update this previously published guideline using this newer platform for data management and guideline development.

DISCLAIMER

Evidence-based guidelines are strategies for patient management, developed to assist physicians in clinical decision-making. This guideline was developed through a comprehensive review of the scientific literature and consideration of relevant clinical experience and describes a range of generally acceptable approaches to diagnosis, management, or prevention of specific diseases or conditions. This guideline attempts to define principles of practice that should meet the needs of most patients in most circumstances.

However, this guideline should not be construed as a rule, nor should it be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed at obtaining the appropriate results. It is anticipated that it will be necessary to approach some patients' needs in different ways. The ultimate judgment regarding the care of a particular patient must be made by the physician in light of all the circumstances presented by the patient, the available diagnostic and treatment options, and available resources.

This guideline is not intended to define or serve as a standard of medical care. Standards of medical care are determined on the basis of all the facts or circumstances involved in an individual case and are subject to change as scientific knowledge and technology advance. The recommendations in this guideline reflect the state of current knowledge at the time of publication. Given the inevitable changes in the state of scientific information and technology, this guideline will be considered relevant for a period of 5 years after publication, in accordance with the inclusion criteria of the ECRI Guidelines Trust.[12]

METHODS

The full, detailed methodology is listed in the appendix. (**See Appendix A, Supplemental Digital Content 1**, which shows the full guideline methodology, ***http://links.lww.com/PRS/E876***.)

Work Group Selection Process

The 2012 guideline was revised by a 15-person multidisciplinary work group consisting of members of the American Society of Plastic Surgeons, the American Society of Breast Surgeons, the American Physical Therapy Association, and a patient representative. All applicants were required to submit a conflict-of-interest disclosure form for membership consideration. The cochairs were free of all relevant conflicts of interest for the duration of the project in accordance with the American Society of Plastic Surgeons conflict-of-interest policy.

Clinical Question Development

Work group members used a consensus-based approach to select the seven clinical questions to be addressed in this evidence-based guideline.

Literature Search

Multiple literature searches were performed between 2018 and 2019 to identify relevant studies published from 1990 to 2019 in all relevant databases using appropriate combinations of MEDLINE Medical Subject Headings terms and keywords, as permitted by the search functionalities of each database/journal.

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Critical Appraisal of Evidence

A modified version of the Grading of Recommendations Assessment, Development and Evaluation process was used to evaluate the methodologic quality of clinical studies and the strength of clinical evidence. A total of 5429 studies were identified from databases during the literature search, and 3958 were screened after excluding duplicate records. After screening and critical appraisal were performed, 114 studies were selected for this guideline.

Grading of Recommendations

Clinical practice recommendations were developed using BRIDGE-wiz software,[13] during an in-person meeting in the spring of 2019 and refined during subsequent conference calls and online discussions. Each recommendation in this guideline is accompanied by a grade indicating the strength of the recommendation, which was determined by considering the overall level of evidence supporting the recommendation and the judgment of the guideline developers as to the preponderance of benefits and harms. See Figure 1 and Table 1 for explanations.

Peer Review and Public Comment Process

The draft guideline was peer reviewed by members and/or committees of the American Society of Plastic Surgeons, the American Society of Breast Surgeons, the American Physical Therapy Association (all groups represented on the work group), and the College of American Pathologists (invited to review the section on pathology), using the Appraisal of Guidelines for Research and Evaluation Global Rating Scale instrument.[14]

Guideline Approval Process

After the peer review and public comment process, the guideline draft was reviewed and modified by the work group after consideration of peer review and public comments. The final

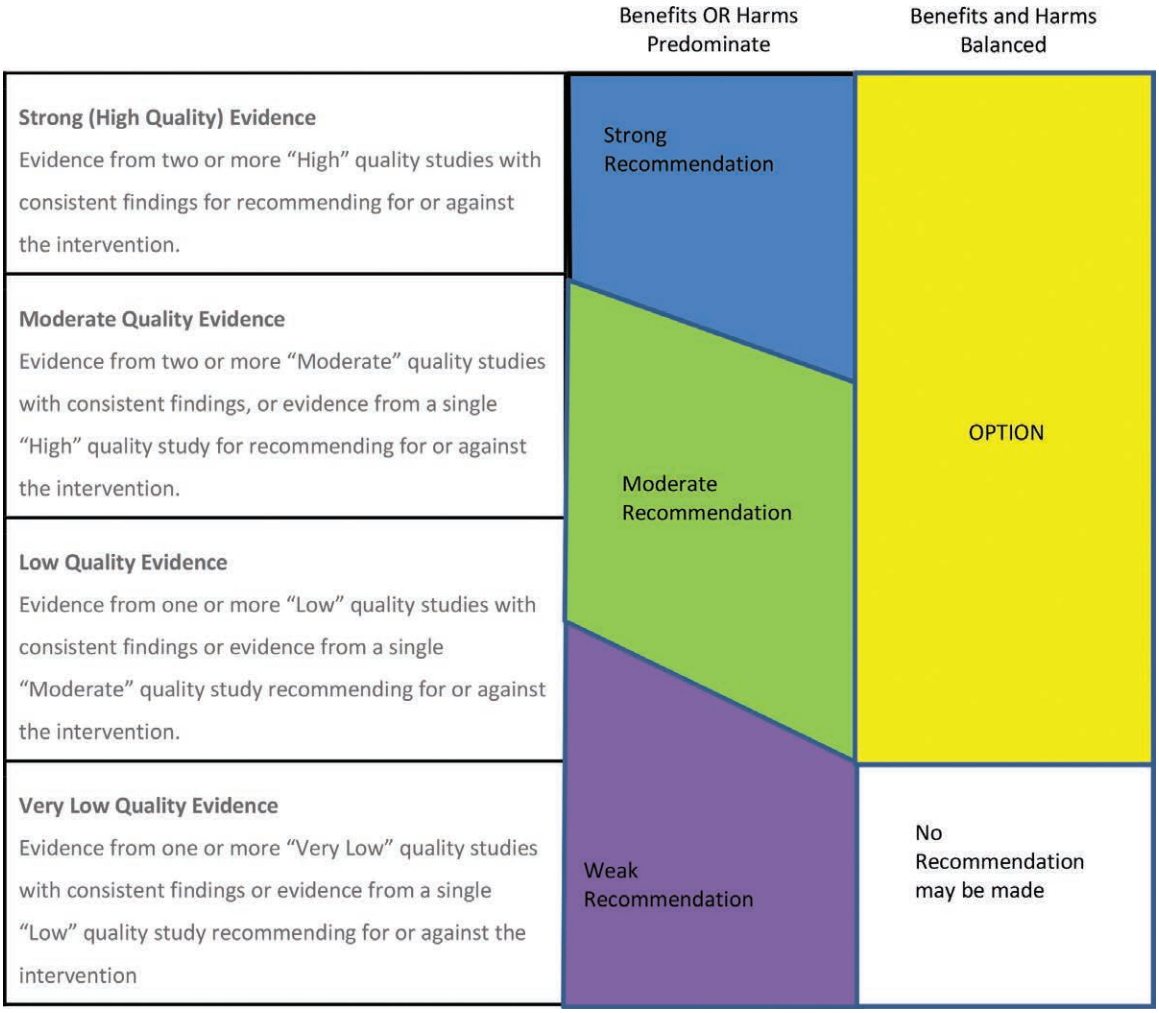


Fig. 1. American Society of Plastic Surgeons strength of aggregate evidence and recommendations.

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Table 1. American Society of Plastic Surgeons Recommendation Definitions and Levels of Adherence

Recommendation	Definition	Level of Adherence
Strong	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and quality of evidence is excellent (moderate or strong) or unobtainable.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Moderate	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and the quality of evidence is good but not excellent (or is unobtainable).	Clinicians would be prudent to follow a moderate recommendation but should remain alert to new information and sensitive to patient preferences.
Weak	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), but the quality of evidence is low or very low.	Clinicians would be prudent to follow a weak recommendation but should remain alert to new information and very sensitive to patient preferences.
Option	An option is provided when the aggregated data show evidence of both benefit and harm that appear similar in magnitude for any available courses of action.	Clinicians should consider the options in their decision-making, but patient preference may have a substantial role.

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guideline was approved by the executive committee of the American Society of Plastic Surgeons in August of 2020.

Plan for Updating Guideline

The guideline will be updated within 5 years or when newly published evidence may result in a change to current recommendations. The American Society of Plastic Surgeons uses a digital platform (Presentation and Evaluation of Evidence-based Research) to store literature and data, thereby facilitating an efficient updating process.

RECOMMENDATIONS

A summary of recommendation statements is shown in Table 2. Other tables discuss the components the work group considered in formatting and rating the recommendations.

Table 2. Recommendations with Level of Evidence and Strength of Recommendation

Recommendation	Description	Evidence Quality	Recommendation Strength
1	The work group recommends that postmenarche female patients presenting with breast hypertrophy should be offered reduction mammaplasty surgery as first-line therapy over nonoperative therapy based solely on the presence of multiple symptoms rather than resection weight.	High	Strong
2	The work group recommends that clinicians counsel postmenarche patients with symptomatic breast hypertrophy considering reduction mammaplasty that they may have a higher risk of complications if they are older than 50 yr, have a body mass index greater than 35 kg/m^2, or require chronic corticosteroid use (all independent variables).	Moderate	Moderate
3	The work group recommends that postmenarche female patients presenting with symptomatic breast hypertrophy identified as nicotine users be referred to nicotine/tobacco cessation programs and encouraged to stop smoking before surgery.	Moderate	Moderate
4	The work group finds that it is acceptable for plastic surgeons to perform either superomedial pedicle or inferior pedicle techniques for reduction mammaplasty for postmenarche female patients presenting with symptomatic breast hypertrophy (other less common techniques were not reviewed).	High	Option
5	The work group suggests that plastic surgeons infiltrate epinephrine-containing solutions at the surgical site for postmenarche female patients undergoing reduction mammaplasty.	Moderate	Moderate
6	The work group recommends that plastic surgeons should administer local anesthetic for postmenarche female patients undergoing reduction mammaplasty.	High	Strong
7	The work group recommends that plastic surgeons incorporate nonnarcotic strategies for reducing postoperative pain in female patients undergoing reduction mammaplasty.	Low	Moderate
8	The work group recommends that plastic surgeons not routinely use intraoperative drains for female patients undergoing reduction mammaplasty.	Moderate	Moderate
9	The work group recommends that plastic surgeons send breast tissue removed from postmenarche female patients undergoing reduction mammaplasty for pathologic evaluation.	Moderate	Moderate
10	The work group suggests that when the Surgical Care Infection Program protocol is followed, clinicians not routinely prescribe postoperative oral antibiotics for female patients undergoing reduction mammaplasty surgery.	Low	Weak

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Table 3. Recommendation 1

Characteristic	Findings
Aggregate evidence quality	High
Strength of recommendation	Strong
Benefits	• Avoiding cost of ineffective nonoperative therapy • Improving QOL • Faster relief of symptoms (pain, bra strap grooving) • Avoiding side effects from nonoperative therapies intended to help • Faster return to activity • Greater patient satisfaction • Improved function
Risks, harm, cost	• Potential surgical complications • Anesthesia (cost and potential complications) • Time off work • Potentially reduce ability to breastfeed • Postoperative pain
Benefit-harm assessment	Preponderance of benefit
Value judgments	Not specific to volume or resection weight, evidence shows all symptomatic patients benefit from surgery
Intentional vagueness	None
Role of patient preferences	Even though surgery is offered, patient still may choose not to have surgery, but data support that surgery is definitive for correction of this disorder
Exclusions	Patients who are not good candidates for surgery
Differences of opinion	None

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Recommendation 1

The work group recommends that postmenarche female patients presenting with breast hypertrophy should be offered reduction mammaplasty surgery as first-line therapy over nonoperative therapy based solely on the presence of multiple symptoms rather than resection weight.

Rationale

Symptomatic breast hypertrophy is a medical condition that causes a significant health burden for patients.[15–17] There is no study to date that supports the finding that nonoperative management provides effective long-term relief of symptoms. Instead, patients have an increased obesity risk associated with difficulty exercising because of breast size impacting posture and upper spinal movement. Symptomatology may also require chronic administration of pain medication, emergency room evaluations, physical therapy, and missed work and/or school days.[2,15,16] A study by Sanal et al.[18] demonstrated that gigantomastia is associated with significant spondylosis in the thoracic spine. Benditte-Klepetko et al.[15] showed that the incidence of degenerative spine disorders and depressive symptoms correlates with increasing breast weight. Not surprisingly, patients with symptomatic breast hypertrophy often complain of chronic neck and back pain that are not effectively controlled conservatively.[3] Gaskin and Richard demonstrated the economic burden on patients with chronic pain that includes cost of treatment, missed workdays, and lower wages.[19]

Reduction mammaplasty surgery is considered standard of care for symptomatic breast hypertrophy. Several studies have demonstrated physical and psychological benefits, including improvement in degenerative spine disease, pain, functional capacity, depression, patient satisfaction, and psychosocial and sexual well-being.[2–9,20,21] Quantifiable data using BREAST-Q reduction surveys have shown validated, improved outcomes and satisfaction among women undergoing reduction mammaplasty.[17,22,23]

Numerous studies have demonstrated the lack of correlation between the amount of resection weight and symptomatic relief.[3,24–27] In two studies, Spector et al.[8,9] found that a reduction mammaplasty removing less than 500 g of tissue offered symptom relief and improved quality of life. The Breast Reduction Assessment of Value and Outcomes study compared quality-of-life outcomes in postoperative patients with resection weights less than 500 g and patients with resection weights greater than 500 g. The two groups experienced equivalent improvement across five validated measures of health burden.[25] The evidence demonstrates that resection weight does not accurately predict patient-oriented outcomes such as alleviation of pain and related symptoms, and should not be the primary determinant of medical necessity.[2,3,8–10,24,27–31]

The Breast Reduction Assessment of Value and Outcomes study proposed a new symptom-based definition of medical necessity for reduction mammaplasty.[25] It recommends a simplified instrument, the Physical Symptoms Count, to

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assess seven symptoms of breast hypertrophy: upper back pain, rashes, bra strap grooves, neck pain, shoulder pain, numbness, and arm pain. The presence of two or more of these symptoms, occurring most or all of the time, successfully differentiated a group of reduction mammaplasty patients from a control group containing both nonhypertrophic and hypertrophic subjects: 89.9 percent of operative subjects reported experiencing two or more symptoms all or most of the time, compared with only 2 percent of normal controls. Kerrigan et al. also compared the overall improvement in quality of life between operative subjects with more than two and less than two persistent symptoms. The results confirmed that patients with multiple symptoms experienced significantly more improvement than those reporting fewer symptoms across all five measures of quality of life.

Reduction mammaplasty has historically been considered either reconstructive or cosmetic and required documentation showing the presence of symptoms for 3 to 12 months before surgery was considered or could be covered financially by insurance. A companion revision of the insurance coverage criteria document will be released following the publication of this guideline. Following a review of the evidence, the work group has concluded that reduction mammaplasty should be offered as first-line treatment for symptomatic patients and should not require documentation of symptoms for a significant length of time. Two studies reviewed compare early surgery versus delayed surgery.[7,32] The first high-quality prospective randomized study examined the effect of bilateral reduction mammaplasty on depression and anxiety.[32] Women were randomized to either early surgery (n = 36) or delayed surgery (n = 37). The presence of clinical anxiety and depression were assessed using the Hospital Anxiety Depression Score. Those women who had earlier surgery (within 6 weeks of assessment) demonstrated significantly less ($p < 0.001$) clinical anxiety and depression than those undergoing delayed surgery.[32]

A randomized controlled trial using a modification of the Beck Depression Inventory demonstrated a reduction of depression and anxiety after reduction mammaplasty (moderate quality).[7] Details from this study include significant increases in self-esteem ($p = 0.03$), reduced depression ($p < 0.01$), and reduced anxiety ($p = 0.04$) in women who underwent surgery (n = 29) versus conservative treatment (n = 35).

Another high-quality randomized study examined the benefits to quality of life following bilateral reduction mammaplasty using multiple quality-of-life validated self-reported scales.[5] The delayed surgery (control) group underwent a trial of nonsurgical treatment that included medication, use of special brassieres, and physical therapy (a handout on upper body exercises to be completed three times per week). Thirty-six women underwent early surgery. The early surgery group demonstrated significant improvements in emotional stability and extroversion when compared to the control group (n = 37). There was strong support for a recommendation on the use of validated quality-of-life questionnaires to assess patient experience of care and emotional well-being that were supported by the previous American Society of Plastic Surgeons reduction mammaplasty guideline.[10]

Not all patients are good candidates for surgery, for reasons related to medical comorbidities that increase complications from anesthesia and delay healing. For those who are not good candidates for surgery or elect not to pursue surgery (because of risks related to any elective procedure) nonoperative therapy (medication, use of special brassieres, and physical therapy) is still recommended if it helps with symptom relief.

In conclusion, there is good evidence supporting the benefits of reduction mammaplasty for patients with symptomatic breast hypertrophy. This surgery should be predicated on the presence of symptoms rather than the weight of tissue removal. Strong evidence supports early surgical intervention rather than a required period of conservative therapy.

Recommendation 2

The work group recommends that clinicians counsel postmenarche patients with symptomatic breast hypertrophy considering reduction mammaplasty that they may have a higher risk of complications if they are older than 50 years, have a body mass index greater than 35 kg/m^2, or require chronic corticosteroid use (all independent variables).

Rationale

Concerns have been raised regarding risk factors that could impact the outcomes of patients seeking reduction mammaplasty. Age, body mass index, medical comorbidities, tobacco use, and chronic corticosteroid use have been studied to determine their effect on risk and outcomes.

Patient Age

The preponderance of data suggests that, in aggregate, increasing age is a risk factor for

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Table 4. Recommendation 2

Characteristic	Findings
Aggregate evidence quality	Moderate
Strength of recommendation	Moderate
Benefits	• Appropriately set expectations • Obtain a detail-specific informed consent • Patient awareness of risk • Obese patients may want to lose weight before surgery to reduce risks • Consultation to determine whether discontinuation of corticosteroids is possible and/or recommending supplemental vitamin A to mitigate risk
Risk, harm, cost	• A patient with one or more of these risk factors may be discouraged from surgical treatment, and thus suffer ongoing symptomatology related to breast hypertrophy
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Differences of opinion	None

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increased complications. Overall, six studies have shown increased risk of complications in older women.[33–38] Five studies failed to demonstrate age as a significant risk factor for any complication.[39–43] One study showed an association between older age and a reduced risk of delayed wound healing.[39]

In a study of 124 women, Ogunleye et al.[35] demonstrated that the risk of all complications increased 3 percent per year of age (OR, 1.03; 95 percent CI, 1.00 to 1.08). Akyurek and Chappell,[33] in a study of 69 women, showed that the risk of developing any complication doubled with every additional year of increasing age (OR, 2.03; 95 percent CI, 1.11 to 3.74). In a large study, 2152 women older than 50 years suffered double the incidence of postoperative infection.[34] Using the same patient population, this increased risk of infection was not present in either women aged 40 to 50 years or women younger than 40 years.[37] Age may also have an impact on other important complications. For example, in a nationwide registry of 5371 women who underwent a reduction mammaplasty, as age increased there was a significant increase in postoperative thromboembolic events (deep venous thrombosis, pulmonary embolism).[36]

Conversely, Sutinen et al.[43] found no association of age with complications in a Finnish cohort of 483 patients. The National Surgical Quality Improvement Program database with 13,503 breast reduction patients was analyzed by Hillam et al.,[40] who found no association between patient age and complications. However, the reporting window was only 30 days and the National Surgical Quality Improvement Program only captures inpatient data.[40] Cunningham et al.[39] analyzed 179 patients who participated in the Breast Reduction Assessment: Value and Outcomes study in 2004. They reported that increasing patient age was associated with a reduction in delayed wound healing, and with risk reduction averaging 7 percent per year of age. However, no other study has reproduced these findings.[39]

Patient Body Mass Index

A large number of studies supported the association between body mass index greater than 35 kg/m^2 and the risk of infection and wound healing, but with equivocal results for patients with body mass indexes between 25 and 35 kg/m^2.[34,37,40,44] Sutinen et al.[43] showed a 12 percent increase in the risk of minor complications (mostly wounds) for every unit increase in body mass index. Hillam et al.[40] demonstrated a 5 percent increased risk of any wound complications per unit increase in body mass index. Fischer et al.,[45] in an analysis of National Surgical Quality Improvement Program data on 3538 patients, showed a 2.1-fold increased risk of surgical complications in patients with a body mass index greater than 35 kg/m^2 when compared to patients with a body mass index less than 35 kg/m^2. Manahan et al.[34] showed that patients with a body mass index greater than 35 kg/m^2 had a 1.7 times increased risk of wound healing problems, a 2.3 times increased risk of infection, a 2.9 times increased risk of seroma, and double the risk of fat necrosis compared to non–morbidly obese women. Thus, patients with a body mass index greater than 35 kg/m^2 have a higher risk of complications that includes infection and wound healing.

Corticosteroid Use

There were several studies supporting the association between the use of chronic corticosteroid medication and wound healing difficulties (moderate evidence).[40,42,44] The risk associated with

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chronic corticosteroid use might be mitigated by discontinuance of the medication preoperatively and supplementation with vitamin A perioperatively but there is a lack of evidence for this.

Diabetes Mellitus

There was no association identified between diabetes mellitus (type 1 or 2) and complications of reduction mammaplasty with studies available for review.[36,37,42,43,46] It is important to note that the incidence of diabetes mellitus in the studies was fairly low, ranging from 1 to 4.7 percent, and may represent inclusion of medically optimized patients with well-controlled diabetes mellitus. In contrast, diabetes mellitus is often associated with other comorbidities (such as morbid obesity) that may preclude patients from undergoing elective reduction mammaplasty surgery, especially when glucose levels are poorly controlled. Certainly, research is necessary to further delineate the relative risks of diabetes mellitus and other comorbidities.

Recommendation 3

The work group recommends that postmenarche female patients presenting with symptomatic breast hypertrophy identified as nicotine users be referred to nicotine/tobacco cessation programs and encouraged to stop smoking before surgery.

Rationale

Nicotine use perioperatively is considered an important factor adversely affecting wound healing and postoperative recovery following reduction mammaplasty.[33,34,40–42,44–50] One moderate quality study defined smoking as more than three cigarettes per day.[48]

Twenty studies were reviewed that examined the effects of smoking on patients who underwent reduction mammaplasty surgery. None of the studies had comparison groups. Multivariate logistic regression analyses were performed in many of the studies. Five did not have adjustments for confounding factors. The majority of studies ($n = 12$) were of high or moderate quality,[33,34,37,40–42,44,46–50] and these studies showed that perioperative nicotine use significantly increased overall complication rates.[33,41,42,44–47,50]

Although the majority of studies examined the incidence of total wound complications[40,48] and infections (both superficial and deep) as outcomes following reduction mammaplasty, Fischer et al.[45] examined major surgical complications more broadly and reported similar findings of significantly increased complication rates in smokers. Bikhchandani et al.[47] found a significantly increased incidence of T-junction necrosis with perioperative smoking following reduction mammaplasty. However, there were a few studies that looked at the incidence of specific complications following reduction mammaplasty such as infection, thromboembolic events, fat necrosis, hematoma, or seroma formation, in which there was no increased incidence in smokers.[36,39,47,48,51–53]

Overall, moderate quality evidence was found to support the recommendation (moderate strength) that patients should be informed preoperatively of the increased risks of complications including infection, T-junction necrosis, and wound complications with simultaneous smoking and reduction mammaplasty. These studies showed increased odds of complications from two to five times the risk compared to nonsmokers.

The goal to improve outcomes and overall health of the patient preoperatively may delay surgery and add cost to the patient's care for smoking cessation treatment. Studies from the general surgery literature show a reduction of postoperative complication rates by 20 to 30 percent after 4 weeks of smoking

Table 5. Recommendation 3

Characteristic	Findings
Aggregate evidence quality	Moderate
Strength of recommendation	Moderate
Benefits	• Reduce postoperative complications, especially wound healing • Reduce anesthesia complications • Improve overall health • Decrease risk of infections
Risk, harm, cost	• Delay of surgery • Cost to patient
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	Did not define length of time for delay of surgery because of lack of evidence and did not specify which nicotine products
Role of patient preferences	Patient can choose type of cessation intervention
Exclusions	None
Differences of opinion	None

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Table 6. Recommendation 4

Characteristic	Findings
Aggregate evidence quality	High
Strength of recommendation	Option
Benefits	• There are no significant differences in benefits between the two techniques with regard to surgical complications or patient-reported outcomes
Risk, harm, cost	• There are no differences in risks, harms, or costs between the two techniques with regard to complications and patient-reported outcomes
Benefit-harm assessment	Balance of benefits and harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Scar patterns may be different and should be discussed; there may be differences in shape long term, and these should be discussed
Exclusions	None
Differences of opinion	None

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cessation.[54,55] Patients may choose the type of cessation intervention they prefer. Overall, the evidence demonstrates a lower risk of complications when nicotine is ceased before surgery. The American College of Surgeons provides guidelines and resources on smoking cessation related to surgery.[56]

Recommendation 4

The work group finds that it is acceptable for plastic surgeons to perform either superomedial pedicle or inferior pedicle techniques for reduction mammaplasty for postmenarche female patients presenting with symptomatic breast hypertrophy (other less common techniques were not reviewed).

Rationale

There are multiple pedicle and skin excision techniques used in reduction mammaplasty. The inferior pedicle technique with Wise pattern, described by Robbins in 1977,[57] is the most commonly used procedure because it is reliable in preserving nipple-areola perfusion and has successful outcomes across a wide range of reduction sizes.[58] The superomedial pedicle technique described by Lassus[59] and later modified by Lejour[60,61] and Hall-Findlay[62] preserves upper-pole fullness, has a decreased tendency for bottoming-out, and avoids a long transverse scar when performed with a vertical scar.[35] The work group recognizes that there may be other evidence-based techniques; however, because of the volume of literature, this review focused on the two most common pedicles. This guideline does not comment on the safety or efficacy of other techniques, nor does it imply or suggest the superiority of the named techniques compared to any other techniques not listed.

A study by Antony et al.[58] was a retrospective demographically matched cohort study comparing 50 patients who underwent the superomedial pedicle technique with 50 patients who underwent the inferior pedicle technique. Importantly, all patients in each group (superomedial and inferior pedicle) achieved symptomatic relief, and there was no statistical difference in either major or minor complications between the two groups.[58] In another study by Ogunleye et al.,[35] nonmatched groups were compared. Patients with diabetes mellitus and obesity were more likely to undergo surgery using the inferior pedicle technique compared with the superomedial pedicle technique. Patients who underwent the inferior pedicle technique also had more breast tissue resected, with a mean resected tissue weight of 1090 g (inferior pedicle) versus 546 g (superomedial pedicle). Although the overall complication rate was actually lower in the superomedial pedicle group with a rate of 25.6 percent versus the inferior pedicle group with a rate of 47.1 percent, when matched for age and resection weight, there was no significant difference in major or minor complications. There were no significant differences in complication rates of either technique, even when comparing the techniques in patients that had large resection weights (>1000 g). This study was limited by the preoperative surgeon selection bias and variable follow-up.

Another study compared pedicle type alone in severe macromastia patients with a mean resection weight of approximately 1300 g in both groups.[63] This was a prospective study with 50 superomedial pedicle patients matched based on age, body mass index, medical disorders, smoking status, and preoperative breast measurements to 50 inferior pedicle patients with a 1-year postoperative follow-up. There was no difference in complication rates, and bottoming-out occurred in both groups.

A large randomized prospective study of 255 patients comparing superomedial pedicle to

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inferior pedicle reduction mammaplasties evaluated outcomes and included patient-reported outcomes data questionnaires.[64] In this study, the weights of resection were limited to less than 1000-g reductions and comparable between groups. There was a clinically important improvement between baseline and 1 year postoperatively in both groups in the Health Utilities Index Mark 3 and the Breast-Related Symptoms Questionnaire. However, there was no statistically significant difference observed between the two techniques in health-related quality of life. Most patients achieved symptomatic relief from surgery in the first postoperative month.[64]

Muslu et al.[65] specifically focused on sensory changes following superomedial versus inferior pedicle technique. In this case-matched prospective study, breast sensation did not change in the superomedial pedicle group; however, sensation in upper medial and lower lateral portions of the breast was reduced in the inferior pedicle group. The total amount of change in algometry and two-point discrimination tests of the areola and breast skin were similar in both groups. Therefore, regarding sensory changes to the areola and breast skin, both pedicles are safe and reliable.[65]

Two prospective high-quality and three low-quality studies reveal no differences in major and minor complications including a specific study on the complication of sensitivity changes between superomedial and inferior pedicles.[35,58,63–65] Furthermore, both techniques were similar in terms of improved quality of life, patient satisfaction, and relief of symptoms. Superomedial pedicles were performed safely in a range of breast weight resections, including patients with resected weights over 1000 g.[63]

Further research is needed to address the relationship between pedicle technique and subsequent breastfeeding ability. A recent systematic review[66] concluded that pedicle techniques that preserve all or part of the column of subareolar parenchyma increase the likelihood of breastfeeding success after reduction mammaplasty. However, a direct comparison of pedicle techniques was not possible because of widely varying definitions of breast-feeding "success" and issues with study design. Measures of success used in the literature vary from exclusive breastfeeding for 24 months to supplemental nutrition for at least 1 week. Many studies do not control for nonsurgical variables, such as psychosocial and cultural factors, that contribute to breast-feeding "failure." Future studies should assess ability to lactate, use comparable measures of success, and also evaluate nonsurgical reasons for breast-feeding failure.

Recommendation 5

The work group suggests that plastic surgeons infiltrate epinephrine-containing solutions at the surgical site for postmenarche female patients undergoing reduction mammaplasty.

Rationale

A meta-analysis and several studies consistently showed that the use of epinephrine-containing solutions significantly reduced blood loss.[67–70] The meta-analysis demonstrated a related decrease in the need for blood transfusion when epinephrine infiltration was used. In addition, two studies suggest that rebound bleeding with adrenaline dissipation did not occur.[67,69] Most studies found

Table 7. Recommendation 5

Characteristic	Findings
Aggregate evidence quality	Moderate
Strength of recommendation	Moderate
Benefits	• Reduce blood loss • Reduce hypotension • Reduce need for intraoperative fluids • Reduce need for blood transfusions • Faster recovery • Possible outpatient surgery
Risk, harm, cost	• Cost • Preparation time • Tachycardia
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	• Not specifying which type of epinephrine-containing solution • Not specifying how administered • Not specifying how much to give
Role of patient preferences	None
Exclusions	Patients with known sensitivity to epinephrine
Differences of opinion	None

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no significant differences in the average tissue removed per breast, operating time, or postoperative drainage,[67,70] although two showed operative time to be shorter.[68,69] Postoperative complications such as hematomas, nipple necrosis, or wound healing problems were equivalent.[68]

The referenced studies vary with respect to the concentration of epinephrine used—ranging from 1:100,000 (0.00001 mg/liter) to 1:1,000,000 (0.000001 mg/liter)—and whether a local anesthetic was included in the epinephrine solution. The volume of infiltrate varied between 25 and 1000 ml, and the method of infiltration varied. Therefore, the recommendation is intentionally vague as to method of infiltration, volume, and concentration.

Recommendation 6

The work group recommends that plastic surgeons should administer local anesthetic for postmenarche female patients undergoing reduction mammaplasty.

Rationale

Overall, the data strongly support the administration of local anesthetic as an adjunctive pain management modality for patients undergoing reduction mammaplasty.[71–77] The preponderance of evidence demonstrated that intraoperative or postoperative infiltration with local anesthetic (lidocaine or bupivacaine) significantly decreased the administration of postoperative narcotics[71–73,75,77]; improved postoperative pain scores[72,73,77]; decreased length of stay (time to discharge, in hours)[71,72]; and improved outcomes in postoperative nausea and vomiting[73] and in postoperative patient satisfaction.[73] Although Christie et al.[78] showed no significant reduction in pain scores, postoperative nausea and vomiting, or postoperative narcotic use, the lidocaine concentration in their study was 0.05%, approximately seven times lower than the concentration used in other protocols.

The addition of epinephrine to local anesthetics is common practice; however, its effect on postoperative pain is unclear in the current literature. Culliford et al.[71] used bupivacaine without epinephrine with improved outcomes compared to placebo. Epinephrine-induced vasoconstriction may result in delayed absorption of local anesthetic with potentially prolonged effects.

With regard to adjunctive regional pain management techniques, two low-quality studies demonstrated that adjunctive use of thoracic paravertebral block was associated with improved postoperative pain and nausea/vomiting and decreased length of stay.[74,76] Injection in the chest wall and administration of paravertebral block are associated with a low risk of pneumothorax. There was no incidence of pneumothorax or other major complications reported in the studies reviewed in which the regional block was performed by the anesthesia team using ultrasound guidance. However, these risks must be taken into consideration during preoperative patient counseling.[74,76] One study showed that thoracic epidural anesthesia decreases postoperative pain and opioid administration.[79] Two studies described a benefit to the use of pectoralis and paravertebral

Table 8. Recommendation 6

Characteristic	Findings
Aggregate evidence quality	High
Strength of recommendation	Strong
Benefits	• Reduce postoperative narcotic use • Reduce time in the PACU • Improve pain scores immediately postoperatively • Reduce PONV • Improve PRO/satisfaction
Risk, harm, cost	• Cost • Allergy • Toxicity • Time in the OR • Small potential risk of pneumothorax
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	• Not specifying which type of local anesthetic to give • Not specifying anatomical location of administration • Not specifying how much to give or vehicle of administration
Role of patient preferences	None
Exclusions	Patients with known adverse reaction to local anesthetics
Differences of opinion	None

PACU, postanesthesia care unit; PONV, postoperative nausea and vomiting; PRO, patient-reported outcome; OR, operating room.

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blocks in reduction mammaplasty.[80,81] Further study of these techniques and comparative studies is required.

In conclusion, the administration of adjunctive local anesthetic improves outcomes in patients undergoing reduction mammaplasty. There are limited data comparing the different types of local anesthetics, location, timing, and vehicle of administration. As such, we cannot make firm recommendations as to the type of anesthetic, mode, location, or timing of injection.

Recommendation 7

The work group recommends that plastic surgeons incorporate nonnarcotic strategies for reducing postoperative pain in female patients undergoing reduction mammaplasty.

Rationale

Since 1999, the number of overdose deaths involving opioids quadrupled, and in 2017, the crisis was deemed a public health emergency by the Department of Health and Human Services.[82] Emerging studies have found that perioperative adjuvant nonnarcotic medications can safely and adequately control pain while decreasing the dose of narcotics required following reduction mammaplasty.

Although the benefits of local anesthetics are discussed in recommendation 6, it is important to highlight the value of their use as a nonnarcotic method to improve pain control also. Two studies using lidocaine in the form of tumescent solution infiltration had conflicting results regarding postoperative opioid use, even though the concentration of lidocaine was considerably lower in the study that showed no difference in narcotic consumption (0.05 percent versus 0.35 percent).[75,78] However, the data are much stronger in support of the use of the longer acting local anesthetic bupivacaine being able to lower postoperative narcotic use, regardless of administration method (pump versus direct tissue infiltration).[71–73,77] All available studies demonstrated a significant decrease in postoperative intravenous or oral opioid administration compared to placebo and conventional treatment groups. Finally, general anesthesia with paravertebral block significantly lowered intraoperative opioid consumption compared to general anesthesia without a paravertebral block in two low-quality studies.[74,76]

Limited evidence suggests that use of nonopioid regimens including preoperative celecoxib and gabapentin are more effective at reducing postoperative opioid use than adjunctive opioid use (i.e., preoperative or intraoperative fentanyl or morphine), whether combined with intravenous sedation or general anesthesia.[83] There is evidence in other plastic surgery procedures (including breast augmentation and breast reconstruction) that ketorolac may reduce perioperative opioid use.[84] Although direct evidence for reduction mammaplasty is lacking, it may also decrease opioid use in this procedure. However, the use of ketorolac in reduction mammaplasty patients has been controversial because of fear of increased hematoma risk. Two studies[85,86] found only a slightly increased risk of hematoma associated with perioperative ketorolac that was nonsignificant in otherwise healthy patients. Two additional studies[87,88] showed a minimally increased risk of developing a hematoma after reduction mammaplasty in women who were administered perioperative ketorolac. Further research is needed before conclusions can be drawn about the risk-to-benefit comparison of ketorolac.

Although the use of other nonnarcotic medications such as other nonsteroidal

Table 9. Recommendation 7

Characteristic	Findings
Aggregate evidence quality	Low
Strength of recommendation	Moderate
Benefits	• Reduce narcotic use • Manage pain • Reduce PONV • Reduce potential for drug diversion
Risk, harm, cost	• Risk of bleeding and hematoma formation with NSAID use • Reduced patient satisfaction with perceived increased pain • Immobility because of higher pain
Benefit-harm assessment	Strong preponderance of benefit
Value judgments	None
Intentional vagueness	• Did not specify which nonnarcotic pain relief • Lack of consistent information regarding route, dosage, timing
Role of patient preferences	Choice of nonnarcotic pain relief may depend on patient factors
Exclusions	Contraindications for NSAID use
Differences of opinion	None

PONV, postoperative nausea and vomiting; NSAID, nonsteroidal antiinflammatory drug.

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antiinflammatory drugs, gabapentin, clonazepam, and oral and intravenous acetaminophen in the setting of reduction mammaplasty has been relatively understudied, the current literature supports their use. However, there is limited information regarding route, dosage, and timing of nonnarcotic analgesics. Additional research is also needed regarding the use of regional block techniques, such as pectoralis and serratus plane blocks. Further high-quality studies are needed to make additional recommendations with respect to nonnarcotic pain strategies for reduction mammaplasty.

Recommendation 8

The work group recommends that plastic surgeons not routinely use intraoperative drains for female patients undergoing reduction mammaplasty.

Rationale

One high-quality study and two moderate-quality studies found no significant difference in the rate of complications with or without drain use in patients undergoing reduction mammaplasty.[89–91] In a randomized trial of 49 consecutive patients undergoing reduction mammaplasty, there were no significant differences in the rate of all complications or any specific complication.[91] In this study, all the patients were randomized to one drained breast with closed suction drainage and another undrained breast. Complications occurred in 12 percent of drained breasts and 10 percent of undrained breasts, with no statistically significant difference. However, the number of individual complications such as wound dehiscence and partial or whole nipple loss was too low to allow meaningful comparison. In addition, the excised breast specimen weights were somewhat low, with a mean of 650 g and maximum weight of 1090 g.

In another randomized trial of British patients, 150 consecutive patients undergoing reduction mammaplasty were randomized to unilateral placement of drains.[90] Twenty-five percent of the patients had an excised breast specimen weight of more than 1000 g. There was no significant difference in hematoma incidence or of any other complication when comparing the drained and undrained breasts. There was also no significant difference in seroma aspiration rates. The number of events (and therefore the power to detect a difference) for most of the complications examined was low. No analysis was performed comparing all complications or comparing complications in larger weight reductions.

Corion et al.[89] performed a clinical trial of 107 consecutive patients undergoing reduction mammaplasty. Fifty-five patients received a drain and 52 were assigned to no drains. There was no significant difference in the rate of complications between the groups. Also, there was no significant difference in pain scores. However, the patients in the no-drain group had a significantly shorter length of stay in the facility, as patients were discharged when they felt comfortable leaving the hospital. No analysis was performed comparing all complications or complications in larger weight reductions. The finding of earlier discharge from the hospital is not relevant to the U.S. population, as the majority of procedures are performed in an ambulatory/same-day surgery setting.

Overall, these studies support the conclusion that there is no clinical evidence for routine use of drains for reduction mammaplasty. More

Table 10. Recommendation 8

Characteristic	Findings
Aggregate evidence quality	Moderate
Strength of recommendation	Moderate
Benefits	• No pain during removal of drain • Reduced cost • Reduced number of visits with surgeon/staff • Increased patient comfort
Risk, harm, cost	• More swelling • Weeping incision • Increased cost of dressing changes • Additional scarring where drain is placed
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Patients with known bleeding disorders
Differences of opinion	None

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Table 11. Recommendation 9

Characteristic	Findings
Aggregate evidence quality	Moderate
Strength of recommendation	Moderate
Benefits	• Early detection of cancer or premalignant lesions • Might alter screening strategies for this patient • Reduce patient anxiety • Detection of high-risk lesions
Risk, harm, cost	• Cost • Detection of benign abnormality, which may lead to increased anxiety and unnecessary workup
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Differences of opinion	None

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evidence is required to replicate these findings and to examine which subpopulations of patients potentially may benefit from the use of closed suction drains (e.g., high body mass index, high reduction weight, and concurrent liposuction patients).

Recommendation 9

The work group recommends that plastic surgeons send breast tissue removed from postmenarche female patients undergoing reduction mammaplasty for pathologic evaluation.

Rationale

The reported incidence of histopathologic abnormalities found at the time of reduction mammaplasty is 3 to 10 percent, with a 0.9 to 2.4 percent incidence of malignancy.[92–95] In addition, there is a benefit in identifying benign but abnormal histopathology in breast tissue that can help in early risk stratification, early diagnosis and treatment, and lifestyle modification for risk reduction. We reviewed several moderate quality reports recommending routine pathologic evaluation of resected breast tissue. Tadler et al.[95] examined the tissue from 534 patients and found abnormal tissue in 76.2 percent of all patients, with 76.0 percent being benign lesions. Furthermore, 2.9 percent of specimens had characteristics associated with an increased risk of malignancy.[95] In the study of 918 patients by Merkkola-von Schantz et al.,[93] 10 percent had abnormal pathologic findings, with a mean age of 49 years. Breast cancer incidence was 1.2 percent, with a 5.5 percent incidence of high-risk lesions. It is important to note that 81 percent of patients in the study found to have abnormal histopathology had normal preoperative imaging. This study demonstrates that preoperative clinical assessment, including mammography, is insufficient to identify women at risk of pathologically relevant findings in reduction mammaplasty specimens. Freedman et al.[96] showed that 644 patients had a 4 percent incidence of pathologic findings, with the risk of having a premalignant or cancerous lesion increasing with age. A study by Sofianos et al.[94] showed that the incidence of abnormal pathologic findings in 200 patients was 2 percent.

We reviewed the literature to determine whether an appropriate age threshold can be established below which routine pathologic analysis is not warranted. Although published data showed a definite increased incidence of abnormal pathologic findings in women older than 40 years, we did not find any evidence to support or counter routine histopathologic evaluation in women younger than 40 years. It is important to note that this does not imply pathologic evaluation for this age group is categorically not needed. It is necessary to discuss the risks with the patient to determine the need for pathologic evaluation. Hospital policies and state laws also play a role in guiding and mandating specimen evaluation in this patient population and should be followed.

Recommendation 10

The work group suggests that, when the Surgical Care Improvement Project protocol is followed, clinicians not routinely prescribe postoperative oral antibiotics for female patients undergoing reduction mammaplasty surgery.

Rationale

Breast surgery is considered a clean case but does have a documented surgical-site infection rate up to 5 percent higher than other clean cases.[97,98] Despite the increased surgical-site infection risk, rates vary considerably among the different breast

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Table 12. Recommendation 10

Characteristic	Findings
Aggregate evidence quality	Low
Strength of recommendation	Weak
Benefits	• Cost • Increase bacterial resistance • Risk of *Clostridium difficile* • Risk of allergic reaction • Increased risk of nausea and vomiting
Risk, harm, cost	• Increased risk of infection • Patient anxiety at not being prescribed antibiotics
Benefit-harm assessment	Preponderance of benefit
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Differences of opinion	None

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operations, including reduction mammaplasty. The Surgical Care Improvement Project provides guidelines[99] for antibiotic prophylaxis to establish bactericidal tissue and serum levels during surgery to reduce the risk of infection, with strong evidence to support administration of antibiotics within 1 hour of skin incision. Guidelines from the Surgical Care Improvement Project state that prophylactic antibiotics should be (1) received within 1 hour before surgical incision, (2) selected for activity against the most probable antimicrobial contaminants, and (3) discontinued within 24 hours after the surgery end time.[99]

Prolonged antibiotic administration may lead to *Clostridium difficile* colitis, the development of antimicrobial resistance, allergic reaction, or other adverse effects and increases costs to the patient and to the greater health care system. Also, little evidence exists with respect to the benefits of prolonged postoperative antibiotic administration in patients undergoing reduction mammaplasty. A recent triple-blinded, randomized control trial by Garcia et al.[100] compared Surgical Care Improvement Project guidelines to 7-day extended antibiotics for elective reduction mammaplasty. The authors found no statistical differences in infections or other surgical complications without prolonged 7-day antibiotics. A limitation of this study is that only patients with a body mass index less than 30 kg/m^2 were included. Ahmadi et al.[101] found that patients who received preoperative antibiotics had a reduced risk of delayed wound healing, and this in turn was associated with lower infection rates. This was not found in the group that received both prophylactic and postoperative oral antibiotics, or in the no-antibiotic group.

The work group concludes that the Surgical Care Improvement Project protocol is sufficient for patients undergoing routine reduction mammaplasty. Under these circumstances, postoperative oral antibiotics are unnecessary and potentially harmful. Future research may identify specific subgroups at higher risk (e.g., obese patients) for whom different strategies may be appropriate.

FUTURE DIRECTIONS

As a result of our analysis, the work group identified several areas of management where additional research may benefit patients undergoing reduction mammaplasty. One such area would be a comparison between different local anesthetic agents and the postsurgical outcomes. Bupivacaine has a more prolonged effect and good supporting data, and may be preferred compared to lidocaine. Thus, a comparison of the different agents would be valuable to the practicing plastic surgeon. The use of regional block techniques (e.g., pectoralis and serratus plane blocks) to improve pain control and satisfaction has yet to be studied. Similarly, nonnarcotic pain management strategies can be better defined to clarify the risks and benefits of these agents (in particular, studies using ketorolac that are higher quality than case-control studies). Even though there is no evidence to support routine use of closed suction drains, larger high-quality studies would be valuable to further examine their potential benefits in high-risk populations, such as patients with high body mass index or concomitant liposuction. Evaluating the role of postoperative oral antibiotics in high-risk patients, especially those with a body mass index greater than 30 kg/m^2, is another area to study further. Further studies evaluating the significance of diabetes mellitus as a risk factor would be an important contribution to this body of research. Finally, studies comparing

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surgical techniques that have a higher probability of successful breast feeding after the procedure would help guide surgeons when this is an important factor for patients.

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