

Evidence-Based Medicine: Abdominoplasty

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Learning Objectives: After reading this article, the participant should be able to: 1. Differentiate between techniques for standard abdominoplasty and liposuction. 2. Assess patients for risk associated with abdominoplasty alone and combined with other procedures. 3. Implement newer modalities for abdominoplasty perioperative pain management. 4. Better understand the implications and techniques for rectus diastasis correction by rectus sheath plication. 5. Understand the evidence for eliminating the need for drains in abdominoplasty.

Summary: This update to past Maintenance of Certification articles offers new perspectives and builds on past knowledge regarding patient assessment, perioperative management, surgical execution, and complications of abdominoplasty. (*Plast. Reconstr. Surg.* 141: 286e, 2018.)

Abdominoplasty continues to be among the common aesthetic procedures in the United States. It's evolved to include liposuction of the anterior abdomen and trunk, concurrent aesthetic breast procedures, and greater emphasis on safety and risk assessment. Unless otherwise stated, abdominoplasty refers to a standard procedure with a lower abdominal horizontal incision, abdominal flap elevation, rectus sheath plication for correction of diastasis, excision of excess tissue, and closure with umbilical repositioning.

This article is not a stand-alone work but rather a continuation of previous abdominoplasty Maintenance of Certification articles,¹⁻³ which should be reviewed. The information provided does not replace the previous articles, but updates and builds upon them. Furthermore, for maximal benefit, papers cited should also be read to better understand the material presented.

METHODS FOR IDENTIFYING EVIDENCE

PubMed was searched for the best available abdominoplasty evidence between January of 2013 and July of 2016. Publications focusing on variations of standard abdominoplasty (panniculectomy, mini-abdominoplasty, circumferential abdominoplasty, body lift, vertical incision abdominoplasty) and on massive weight loss patients were excluded, as were studies for which the full text was not available and non-English language studies.

From the University of Illinois.

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Some publications are based on analysis of three common large databases and will be referred to as Tracking Operations and Outcomes for Plastic Surgeons (TOPS), National Surgical Quality Improvement Program (NSQIP), and CosmetAssure. (See **Appendix, Supplemental Digital Content 1**, which details the TOPS, NSQIP and CosmetAssure entities, <http://links.lww.com/PRS/C615>.) Both TOPS and NSQIP are validated and report major and minor complications. CosmetAssure reports major complications that are used for insurance payments to cover the complication.

PREOPERATIVE ASSESSMENT

As with any procedure, proper consultation must include a detailed medical history and physical examination, with particular attention paid to patient expectations, social issues, significant weight changes, and risk factors for complications. As previously summarized,³ patients with a body mass index greater than 30 are at higher risk for wound complications and seromas, whereas smokers have

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more infections. Even if smoking is stopped for 4 weeks before surgery, the rate of infection is still significant. The lifetime number of cigarettes smoked is associated with more infections.

A CosmetAssure analysis of 25,261 abdominoplasties also showed more major complications in overweight patients.⁴ In the same database, diabetic abdominoplasty patients had more major complications than nondiabetic patients did (6.1 percent versus 3.0 percent), but there was no differentiation between insulin-dependent and non-insulin-dependent diabetics.⁵ Again, in the same database, abdominoplasty patients age 65 years and older had more major complications than younger patients did (3.9 percent versus 5.4 percent).⁶

PROPHYLACTIC ANTIBIOTICS

Contrary to the recommendations of the last Maintenance of Certification article to give a single dose of antibiotic prophylaxis preoperatively, a systematic review was unable to find supporting evidence.⁷ No new publications on duration of prophylaxis or need for antibiotics while drains are in place are available. However, the current standard of practice is to give a dose of antibiotic before incision and every 4 hours (for cefazolin; other antibiotics may have a longer time before redosing) until surgery is completed.

VENOUS THROMBOEMBOLIC EVENT PROPHYLAXIS

Past Maintenance of Certification articles provide detailed venous thromboembolism risk assessment and prophylaxis strategies. The most recent systematic review and meta-analysis⁸ offered these strong recommendations for plastic surgery procedures:

- Consider non-general anesthesia (monitored anesthesia care, local anesthesia with sedation, or neuraxial anesthesia).
- Use intermittent pneumatic compression devices, which are superior to elastic compression stockings.
- Use the 2005 Caprini instrument for venous thromboembolism risk stratification.
- Consider chemoprophylaxis on a case-by-case basis in patients with a Caprini score greater than 8.

Weaker recommendations and findings include the following:

- Do not add routine chemoprophylaxis for venous thromboembolism in non-risk-stratified body contouring patients.

- Preoperative chemoprophylaxis was not associated with an increased risk of hematoma compared with postoperative chemoprophylaxis in the non-risk-stratified plastic surgery population.
- Neither subtype of heparin (low molecular weight or unfractionated) conferred an advantage over mechanical prophylaxis alone for venous thromboembolism risk reduction in the non-risk-stratified plastic surgery population.
- Low-molecular-weight heparin but not unfractionated heparin conferred an increased risk of reoperative hematoma in the non-risk-stratified plastic surgery population.

OUTPATIENT SURGERY

As in the prior Maintenance of Certification article, inpatient or outpatient abdominoplasty performed in accredited surgery centers is reasonable and considered safe for healthy patients.

ANESTHESIA AND ANALGESIA

Since the last Maintenance of Certification article, the following options have been published for perioperative pain control. No additional information on pain pumps is available, and there are no comparisons of nerve blocks with longer-acting local anesthetics to pain pumps.

Pharmacologic Agents

Adequate perioperative pain control is critical for preventions of complications and patient satisfaction. Recent guidelines on the management of postoperative pain should be considered for abdominoplasty patients.⁹ Although beyond the scope of this discussion, multimodal analgesia—the use of a variety of medications with different mechanisms of action, combined with nonpharmacological treatments—should be considered. This includes preoperative celecoxib and gabapentin, and using opioids, nonsteroidal anti-inflammatory drugs, acetaminophen, and gabapentin in the perioperative period. Local anesthetic infiltration at the surgical site may also be beneficial. There is little supporting evidence for the use of topical cold modalities and if used, precautions should be taken to prevent thermal injury in areas of decreased sensibility. Patients and their caregivers should receive an educational treatment plan for pain control and tapering of medications.

Concerns of increased risk of postoperative bleeding associated with nonsteroidal

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anti-inflammatory drugs seem unfounded. A meta-analysis of 27 randomized controlled trials evaluating ketorolac in surgery patients found no increase in bleeding or other adverse events compared to control groups.¹⁰ Pain control with ketorolac was better than that in control patients and equivalent to that when opioids were used. As these findings were based on various types of surgical procedures, not specifically plastic surgery patients or abdominoplasties, the findings should be interpreted in the proper context.

Abdominal Field and Nerve Blocks

Blocking pain signals from the operative site may decrease intraoperative anesthetic requirements, provide better postoperative pain control and earlier ambulation, and lessen opioid use. A review of 64 abdominoplasty patients found favorable results using a long-acting liposomal bupivacaine (Exparel; Pacira Pharmaceuticals, Inc., San Diego, Calif.) for an abdominal field block.¹¹ However, there was no control group for comparison.

In a retrospective comparison of 77 abdominoplasty patients receiving nerve blocks (intercostal T7 to T12, ilioinguinal, iliohypogastric, and pararectus blocks) with bupivacaine, tetracaine, and methylprednisolone, patients had less pain overall, required fewer narcotics, spent less time in the recovery area, had less nausea, and resumed normal activities faster than the control group without nerve blocks.¹²

A newer technique is the transversus abdominis plane block, which involves a local anesthetic injection in the anatomic plane between the internal oblique and transversus abdominis muscles. (See Video, Supplemental Digital Content 2, which displays the transversus abdominis plane block, available in the "Related Videos" section of the full-text article on PRSJournals.com or at <http://links.lww.com/PRS/C616>.) It can be combined with a rectus sheath block which deposits a local anesthetic between the rectus abdominis muscle and the posterior rectus sheath or transversalis fascia. (See Video, Supplemental Digital Content 3, which displays the rectus sheath block, available in the "Related Videos" section of the full-text article on PRSJournals.com or at <http://links.lww.com/PRS/C617>.)

Although transversus abdominis plane blocks are commonly done by anesthesiologists with ultrasound imaging of the proper plane of injection, they can also be done by surgeons intraoperatively under direct visualization after raising the abdominoplasty flap (Fig. 1).



Video 1. Supplemental Digital Content 2, which displays the transversus abdominis plane block, is available in the "Related Videos" section of the full-text article on PRSJournals.com or at <http://links.lww.com/PRS/C616>.

In a retrospective study of 32 abdominoplasty patients, half received open bupivacaine transversus abdominis plane block and the other half received pararectus, ilioinguinal nerve, and iliohypogastric nerve blocks.¹³ Both groups had bupivacaine injected in the rectus plication. The transversus abdominis plane block patients used significantly less hydromorphone in the first 16 hours after surgery, and had a longer time to first request for pain relief medication.

A randomized controlled trial comparing 14 bupivacaine/lidocaine open transversus abdominis plane block abdominoplasty patients to 14 standard care abdominoplasty patients found reduced morphine use, lower pain scores, and earlier ambulation in the transversus abdominis



Video 2. Supplemental Digital Content 3, which displays the rectus sheath block, is available in the "Related Videos" section of the Full-Text article on PRSJournals.com or at <http://links.lww.com/PRS/C617>.

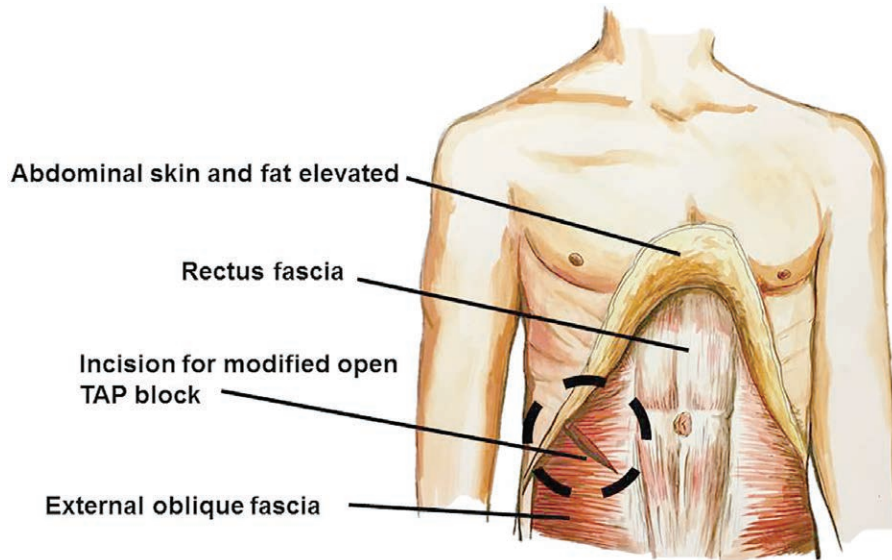


Fig. 1. Open transverse abdominis plane (TAP) block, typically done by a surgeon after abdominal wall exposure. A 1-cm incision is made over the anterior rectus sheath at the level of the umbilicus on each side. Blunt dissection is performed to the plane between the internal oblique muscle and the transversalis muscle. A narrow and rigid tumescent fluid infiltration cannula is then used to inject the local anesthetic in a cranial and caudal direction.

plane block group.¹⁴ Abdominoplasty with neuroaxial (epidural) anesthesia has been described, but comparative studies have not been reported.

EVIDENCE ON SURGICAL TREATMENT PLAN

Planning and execution of a standard abdominoplasty remain relatively unchanged and are well described in a previous Maintenance of Certification article.³ The concepts of lipoabdominoplasty

(simultaneous anterior abdominal liposuction with limited flap undermining and elimination of drains by using internal suture techniques, such as progressive tension sutures or quilting sutures) continue to gain support (Fig. 2). (See **Video, Supplemental Digital Content 4**, which displays lipoabdominoplasty, available in the “Related Videos” section of the full-text article on PRSJournal.com or at <http://links.lww.com/PRS/C618>. See **Video, Supplemental Digital Content 5**, which displays the placement of running barbed

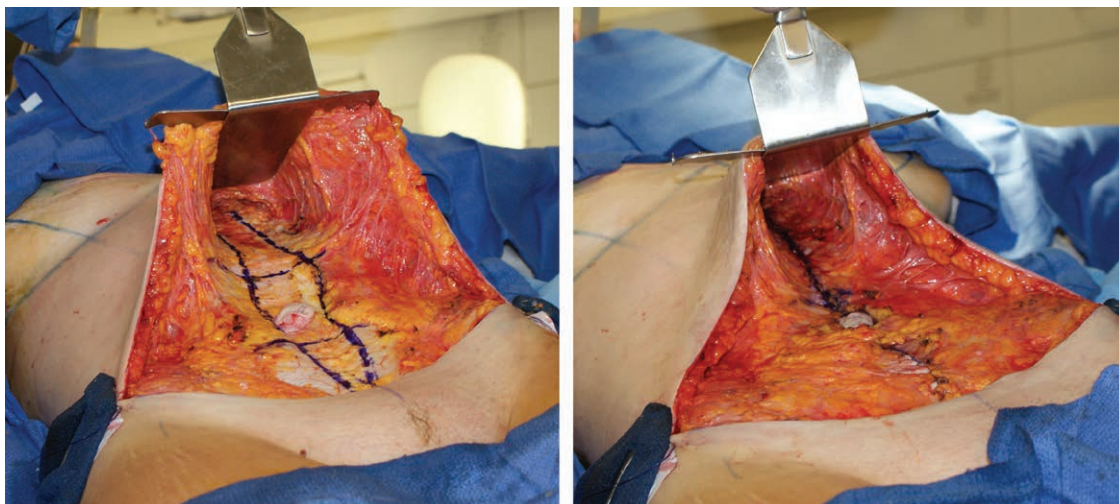


Fig. 2. Abdominal flap elevation with discontinuous undermining during lipoabdominoplasty, before (left) and after (right) rectus plication.



Video 3. Supplemental Digital Content 4, which displays lipoabdominoplasty, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C618>.



Video 4. Supplemental Digital Content 5, which displays the placement of running barbed progressive tension sutures for no-drain abdominoplasty, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C619>.

progressive tension sutures for no-drain abdominoplasty, available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C619>.)

Use of quilting sutures with drains was found to eliminate seromas in abdominoplasty compared with drains only (0 zero versus 12 percent).¹⁵ A review of 127 progressive tension suture abdominoplasties compared with 322 non–progressive tension suture patients found that the progressive tension suture group had fewer seromas (2 percent versus 9 percent) but more scar revisions (17 percent versus 10 percent). Wound complications and hematoma rates were similar between the two groups.¹⁶

A study comparing liposuction, lipoabdominoplasty, and abdominoplasty found high patient satisfaction in all three procedures; the lipoabdominoplasty patients had a similar level of discomfort compared to abdominoplasty alone, while also having the highest level of satisfaction.¹⁷

Lipoabdominoplasty refinements, based on a review of 348 patients, include placing the lowest part of the incision 6 to 8 cm above the introitus, deeper plane liposuction in the lower abdomen, pubic liposuction and lifting with fixation, power-assisted liposuction of the flanks, and Scarpa fascia removal in the lower abdomen.¹⁸ Complications included seroma (2.6 percent), skin necrosis (2.3 percent), and hypertrophic scar (1.7 percent).

Lipoabdominoplasty is technique dependent. To safely preserve flap vascularity, dissection superior to the umbilicus laterally from the midline is generally limited to 5.0 to 7.5 cm, unlike the wider undermining seen in standard abdominoplasty (Fig. 3). This preserves the lateral abdominal perforators that are divided in a traditional abdominoplasty. Upper abdominal liposuction is performed deep to Scarpa fascia to preserve vascularity. Two studies using laser-fluorescence imaging found no difference in abdominal flap perfusion between standard abdominoplasty and the limited dissection technique.^{19,20}

The combination of abdominoplasty and lipoabdominoplasty without drains and suture techniques is reported with low seroma rates. One report of 271 patients emphasized a sub-Scarpa fascia dissection, leaving a thin layer of fat on the abdominal wall fascia, bipolar hemostasis and ligation of larger perforating blood vessels, limited supraumbilical undermining, no compression garments, and early ambulation.²¹ Common complications were seroma (7.7 percent), wound infection (4.5 percent), minor skin breakdown (2.6 percent), and hematoma (1.8 percent), which were within the range of other studies using drains or progressive tension sutures. Another report of 100 patients without drains or suture techniques stressed flap undermining with liposuction, limited direct undermining in the supraumbilical midline, preservation of a thin layer of fibrofatty tissue on the abdominal wall fascia, and targeted postoperative compression with early ambulation.²² Complications included seromas (5 percent), hematoma (2 percent), and abscess (2 percent).

A randomized controlled trial of 160 abdominoplasties found preserving Scarpa fascia reduced seroma formation compared with not preserving it (2.5 percent versus 18.8 percent), and resulted in lower drain output and earlier drain removal.²³

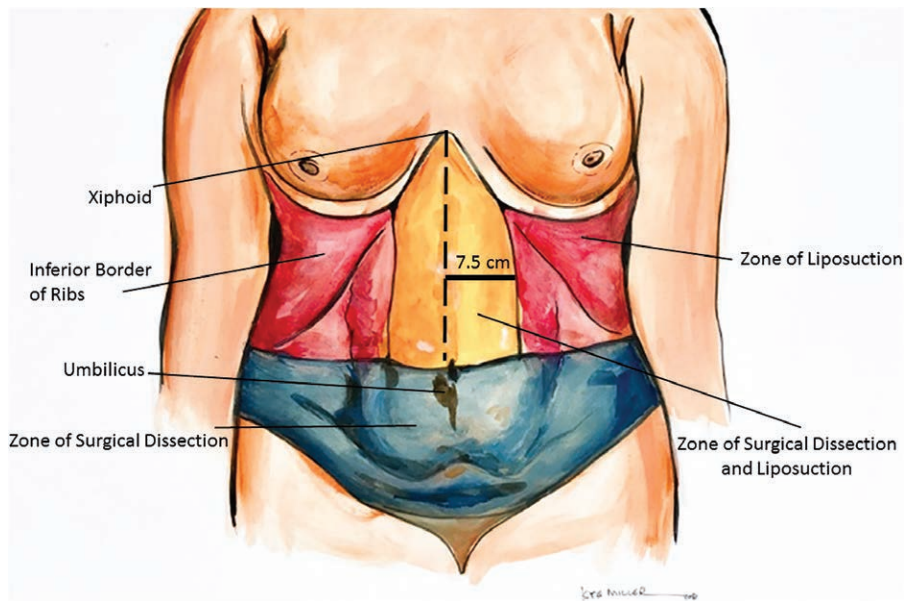


Fig. 3. Typical direct (blue and yellow) and indirect (red) abdominoplasty flap undermining during a lipoabdominoplasty. The indirect undermining is done with liposuction to preserve the perforating blood vessels supplying the abdominal skin.

Although combining liposuction (traditional, power-assisted, Vaser, and ultrasound-assisted liposuction) with abdominoplasty is considered safe with proper technique, laser-assisted liposuction may be problematic. A report found that laser-assisted liposuction of the lateral and central abdomen had a high rate of complications, including skin necrosis, and could not be recommended until proper laser energy parameters are established.²⁴

RECTUS SHEATH PPLICATION AND DIASTASIS REPAIR

The clinical significance of a rectus sheath diastasis is questionable; it is considered a cosmetic deformity rather than a medical problem. However, occasionally patients notice improved quality of life and abdominal wall function after rectus diastasis repair. A prospective study of 55 rectus diastasis repair patients, using a validated ventral hernia pain questionnaire and biomechanical testing, found that certain patients may have a functional benefit with diastasis repair.²⁵ Confirming earlier studies, a report of eight patients with chronic intractable low back pain showed alleviation of pain in all patients at follow-up of 2 to 11 years after wide diastasis plication.²⁶ Seven of the patients completed a validated disability index instrument and had almost complete resolution of their disability. A prospective study of 40 women with substantial back and lumbar

pain who were having abdominoplasty with rectus plication found significant improvements in posture (using radiographic thoracic and lumbar spine measurements) and in pain and quality of life (using validated measurement instruments).²⁷

Use of a rectus sheath plication technique to improve anterior abdominal wall contour is not standardized. The type of suture used for diastasis repair was evaluated in a case-controlled study of 51 abdominoplasty patients with a mean follow-up of 21 months, using physical examination and ultrasound imaging.²⁸ With interlocking continuous absorbable size 0 polydioxanone II loop suture, the postoperative distance between the rectus muscles was the same as in the control group of nulliparous women. Advantages of long-lasting absorbable suture instead of permanent suture include elimination of late suture granuloma and suture palpability in thin patients. Durability of rectus plication using continuous running permanent size 0 nylon sutures was demonstrated with magnetic resonance imaging studies of 20 patients between 6 and 25 months after surgery.²⁹ There was no diastasis recurrence, and there was a significant decrease in abdominal girth. Another study using clinical examination and ultrasound evaluation of rectus plication with size 2-0 nylon interrupted sutures placed in an inverted-X fashion found two diastasis recurrence cases in a group of 20 patients within 1 year of surgery. However, in 18 patients whose surgery was 5 years earlier, there

were no recurrences, which suggests that diastasis recurrence may not be a late event.³⁰ A literature review of rectus sheath plication supports its longevity but suggests that shorter-acting, nonpermanent sutures, such as polyglactin, have a higher recurrence rate compared with longer-acting or permanent sutures.³¹

Tradition vertical rectus plication may be combined with selective transverse plication. A randomized controlled trial of 98 women showed improved aesthetic outcomes with “customized” horizontal plications compared with a control group of vertical plications only.³² Horizontal plication requires the patient to be assessed intraoperatively while flexed 90 degrees at the hips, so that abdominal bulges and protrusions can be identified. After the sites are marked, horizontal mattress sutures are placed in a supine position. This is repeated until no protrusions are seen. Oblique sutures may also be placed as needed. A combined vertical and horizontal suture plication strategy may be particularly useful for massive-weight-loss patients and patients with pronounced rectus diastasis after pregnancy.

In cases of severe rectus diastasis, prosthetic mesh may be used to support the repair. In a small series of cases,³³ a midweight microporous polypropylene mesh was placed in a retrorectus position and anchored with interrupted size 0 polypropylene sutures. At an average follow-up of 15 months, there were no recurrences and the only complications were two minor seromas. The indications for mesh re-enforcement of a diastasis in the absence of a hernia are not defined, and the costs of the mesh product, additional operating room time, and potential for future prosthetic complications must be considered.

The need for rectus fascia plication in the setting of a rectus diastasis may be of less importance in some patients. A randomized controlled trial of 94 postbariatric surgery patients found no difference in a standardized quality-of-life assessment after 1 year between a group who had rectus plication versus a group who did not, as part of an isolated abdominoplasty.³⁴

Increased intra-abdominal pressure from rectus sheath plication may not be clinically relevant in healthy individuals. A prospective trial of 10 patients undergoing abdominoplasty found the mean intra-abdominal pressure had increased from 6.6 to 9.3 mmHg after plication (intra-abdominal hypertension being defined as an intra-abdominal pressure > 12 mmHg), and pulmonary compliance decreased from 40.0 mL/cm to 36.5 mL/cm.³⁵ Although these changes

were statistically significant, they should not have clinical effects in healthy patients. A similar study found no difference in intra-abdominal pressure after rectus plication in patients with a body mass index less than 28, regardless of rectus diastasis width.³⁶ However, in patients with altered pulmonary status (from smoking or chronic obstructive pulmonary disease), it may be prudent to perform a conservative plication to avoid postoperative respiratory problems.

EVIDENCE OF POSTOPERATIVE OUTCOMES

Seroma Reduction with Tissue Adhesives

Tissue adhesives (autologous platelet-rich plasma, thrombin, fibrinogen, lysine-derived urethane) have been used in the operative field to reduce clinically obvious seroma formation. A systematic review³⁷ analyzed seven studies, including five randomized controlled trials which were also subject to a meta-analysis, and found that total drain output was lower for patients who received a tissue adhesive compared with those who did not. However, both groups had a similar incidence of clinically evident seromas. Given the additional cost and lack of evidence to support tissue adhesive use in abdominoplasty, their use should be withheld until well-designed randomized controlled trials demonstrate improved outcomes.

Scars

Long scars associated with abdominoplasty are concerning for patients and may result in revision procedures. In addition to scars migrating superiorly, patients may experience wide, hypertrophic, hypo-pigmented or hyper-pigmented, or vascular-colored scars that may not resolve over time. Common scar improvement treatments include silicone gel sheets or ointments, paper tape, lasers, and manual manipulation. A multicenter, randomized, open-label and self-controlled trial of 36 abdominoplasty patients found that after 12 months, scars treated with Embrace Advanced Scar Therapy (Neodyne Bioscience, Newark, Calif.) had improved scar appearance compared with scars treated with a control silicone gel product.³⁸ The Embrace device is a silicone elastomer applied to the incision site, which then off-loads tension at the incision. While this study demonstrated high-level evidence of scar improvement, there was a high rate of patient skin irritation that required device discontinuation. The additional device cost must be weighed

against the likelihood of scar improvement 2 to 3 years after surgery.

Cutaneous Sensibility

Skin hypoesthesia is common after abdominoplasty and typically improves over time but may not fully resolve. Objective Semmes-Weinstein monofilament testing of abdominoplasty patients found 57 percent of patients reporting subjective sensibly changes, but more than 80 percent were indifferent to it.³⁹ The greatest degree of objective sensibility loss was in the infraumbilical region, but after 2 years, it improved to almost the same level as the remaining regions of the abdomen. Patients should be advised that there will be areas of numbness that can be expected to improve over time.

Weight Loss

Since many abdominoplasty patients are also overweight, weight loss after surgery may be an additional benefit. In a series of 20 abdominoplasty patients, all had weight loss beyond the amount of tissue removed at surgery, of which 75 percent attributed the weight loss to increased satiety.⁴⁰ Patients with a body mass index greater than 24.5 had weight loss of 4.5 percent of body mass index at 1 year. Future studies may define the exact mechanisms of these observations.

Urinary Incontinence

A retrospective review of 100 abdominoplasty patients found that 50 had preoperative urinary incontinence, and in 30 cases, there was improvement after surgery.⁴¹ Patients without a previous caesarean section were more likely to see improvement.

COMPLICATIONS

Nerve Injuries

Although uncommon, peripheral nerve injuries associated with an abdominoplasty can range from dysesthesias to severe and debilitating pain. A systematic review⁴² of 23 studies identified a 2 percent risk of nerve injury in abdominoplasty: 1.5 percent for incisional nerve injury (lateral femoral cutaneous nerve, 1.4 percent; iliohypogastric nerve, 0.1 percent) and 0.5 percent for positional nerve injury (most commonly the sciatic nerve). Decreased abdominal sensation was more common (7.7 percent), while the risk of neuroma or persistent pain was 1.1 percent. Prevention of incisional nerve injuries includes careful dissection around the sites where the lateral femoral

cutaneous nerve and iliohypogastric nerve are at risk for injury. Nerve injuries may present early or late after abdominoplasty, and symptoms may be exacerbated by stimulation or physical activity. Local anesthetic nerve blocks may help in confirming the site of nerve injury. Treatment options include conservative modalities (massage, desensitization) and medications (gabapentin, opioids and nonopioids, tricyclic antidepressants, steroid injections, nerve blocks). If symptoms persist beyond 3 to 6 months, surgical exploration and nerve decompression should be considered.

Results of a cadaver study show that careful dissection 4 cm around the anterior superior iliac spine and preserving Scarpa fascia near the inguinal ligament may decrease the risk of lateral femoral cutaneous nerve injury.⁴³

Obesity-Related Complications

Obesity specifically is a risk factor for complications in surgery, including abdominoplasty. Data from four state ambulatory surgery databases found that obese outpatient plastic surgery patients had more adverse events and higher hospital charges.⁴⁴ For abdominoplasty patients, having more than three medical conditions more than doubled the risk of a hospital-based or acute care setting medical encounter within 30 days from 14 percent to 32 percent. A CosmetAssure review of 25,261 abdominoplasty patients found that patients with a body mass index greater than 25 had more major complications than those with a body mass index less than 25 (3.5 percent versus 2.6 percent).⁴ Given these findings, obese abdominoplasty patients should be advised of the additional risk and financial implications.

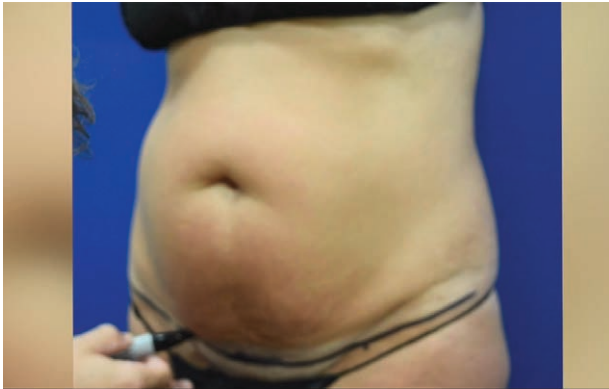
Readmission after Abdominoplasty


National Surgical Quality Improvement Program analysis found a 1.8 percent unplanned hospital admission rate for abdominoplasties.⁴⁵ A different analysis from the program of 2946 abdominoplasties found an 8.5 percent readmission rate,⁴⁶ with the most common causes being wound complications (9.5 percent), pulmonary complications (2.3 percent), and thromboembolic complications (1.2 percent).

COMBINED PROCEDURES

Abdominoplasty Combined with Other Aesthetic Procedures

Aesthetic procedures are frequently combined to either enhance results in the abdominal region



 Video Available Online

Video 5. Supplemental Digital Content 6, which displays preoperative markings for abdominoplasty, is available in the “Related Videos” section of the full-text article on PRSJournal.com or at <http://links.lww.com/PRS/C620>.

(most commonly liposuction) or to improve overall body shape (commonly breast enhancements). The patient demand for multiple procedures must be weighed against the risk of longer and more complex operations.

CosmetAssure data from 25,478 abdominoplasty patients, of which 65 percent were combined with other procedures, showed a 4.0 percent overall 30-day complication rate, compared with 1.4 percent for other aesthetic procedures.⁴⁷ Of complications associated with abdominoplasty (alone or with another procedure), 31.5 percent were hematoma, 27.2 percent were infection, and 20.2 percent were suspected or confirmed venous thromboembolism. Risk factors included male sex (relative risk, 1.8), procedure performed in a hospital or surgery center setting versus an office-based surgery suite (relative risk, 1.6), multiple procedures (relative

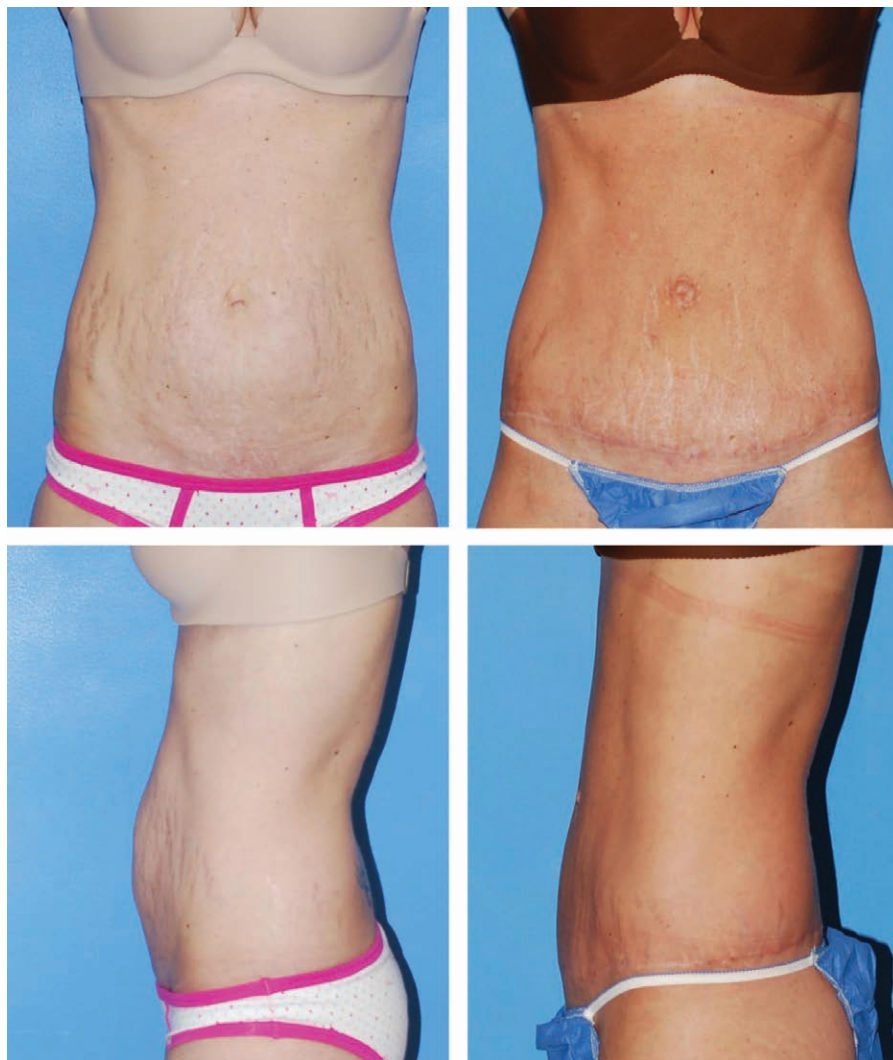


Fig. 4. Typical result before (*left*) and 6 months after (*right*) standard abdominoplasty.

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risk, 1.5), age greater than 55 years (relative risk, 1.4), and body mass index greater than 30 (relative risk, 1.3). For abdominoplasty alone, the complication rate was 3.1 percent. When combined with another procedure, the complication rates were as follows: liposuction and body contouring, 10.4 percent; body-contouring procedure, 6.8 percent; liposuction and breast procedure, 4.6 percent; breast procedure, 4.3 percent; and liposuction, 3.8 percent. One death within 30 days of the procedure was reported in the entire group. Patient selection bias for selecting the surgical setting and adding additional procedures should be considered. Also, it is not known how many of patients had undergone massive weight loss. Nonetheless, surgeons should advise patients on the overall risk of major complications (those which may require more than just office-based treatments and may result in

additional costs) associated with abdominoplasties and the additional risk of combined procedures.

An analysis of 58,756 Tracking Operations and Outcomes for Plastic Surgeons patients found that combining abdominoplasty or panniculectomy with breast augmentation and/or mastopexy ($n = 3693$) did not increase the risk of complications at 30 days in low-risk patients.⁴⁸ Complications for breast procedures alone was 2.1 percent to 4.6 percent; for abdominal procedures alone, 8.7 percent to 9.7 percent; and for combined breast and abdominal procedures, 8.3 percent to 10.9 percent, which was not statistically significant compared with abdominal procedures done alone. For combined cases, complication rates by patient risk stratification were as follows: low risk ($n = 77$ percent), 9.8 percent; moderate risk ($n = 23$ percent), 16.7 percent; and high risk ($n = 1$ percent),



Fig. 5. Typical result before (left) and 6 months after (right) no-drain lipoabdominoplasty with progressive tension sutures.

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38.5 percent. Odds ratios for developing complications in combined cases were 1.77 for American Society of Anesthesiologists rating of 3 or 4; 1.56 for active smoking; 1.29 for an additional procedure; 1.27 for diabetes; 1.08 for body mass index greater than 30; 1.01 for age greater than 53 years; and 0.67 for outpatient procedure. These findings suggest that in low-risk patients, combining abdominal and breast procedures is safe and does not increase 30-day complication rates.

Review of the state of California ambulatory surgery database found that isolated abdominoplasty procedure had a 0.57 percent risk of venous thromboembolism at 1 year, which was about two-fold to three-fold more than for other isolated aesthetic procedures.⁴⁹ When abdominoplasty was combined with liposuction, the rate increased to 0.81 percent, and with hernia repair, to 0.93 percent.

The rate did not increase significantly when combined with breast, face, or extremity aesthetic procedure. Although patient risk stratification was not performed, the authors noted that some patients had significant risk factors for venous thromboembolism, and therefore there may have been suboptimal patient selection. A systematic review of 32 studies comparing abdominoplasty with aesthetic breast procedures to abdominoplasty alone found only four studies with usable data. Based on three of the studies, risk of major complications was higher in the combined group, but the levels of evidence were low or moderate.⁵⁰

Abdominoplasty Combined with Nonaesthetic Procedures

A National Surgical Quality Improvement Program review of 143 combined



Fig. 6. Typical result before (*left*) and 6 months after (*right*) standard abdominoplasty with correction of severe rectus diastasis.

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abdominoplasty and hysterectomy cases found that combined cases had lower risk than when abdominoplasty and hysterectomy were done separately on different dates.⁵¹ Therefore, the risks of two separate procedures must be weighed against the risks of a combined procedure. Incisional hernia repair during abdominoplasty does not increase complications compared with incisional hernia alone, based on an randomized controlled trial of 111 patients.⁵² Perceived quality of life was higher in the combined procedure group.

An analysis of 4925 patients undergoing panniculectomy/abdominoplasty with or without hernia repair found that combined procedures had more complications than panniculectomy/abdominoplasty alone. Hypertension, smoking, and chronic steroid use predicted negative outcomes.⁵³

Based on current information, combining abdominoplasty with other procedures may be acceptable in low-risk patients but not in high-risk patients. Whether this increased risk is more or less than the combined risk of two individual procedures done at different times, is not known. Also, risk reduction strategies, such as more aggressive venous thromboembolism prophylaxis, two-surgeon procedures to reduce surgery time, use of total intravenous anesthesia, and so on, may be beneficial. Surgeons should evaluate each patient individually to assess risk and the ability to tolerate complications. While seromas and minor wound healing issues are generally well tolerated by patients, a major complication with additional hospitalization is not.

CLINICAL EXAMPLES

While there are many ways to make preoperative markings for an abdominoplasty, a proposed method, highlighting the low horizontal incision, vertical guideline marks, and areas of liposuction, is shown in **Video, Supplemental Digital Content 6**, which displays preoperative markings for abdominoplasty, available in the “Related Videos” section of the full-text article on PRSJournal.com or at <http://links.lww.com/PRS/C620>.

Figure 4 shows a thin 42-year-old woman with minimal abdominal fat and a moderate rectus diastasis and striae. After a standard abdominoplasty, some striae remain but the diastasis is corrected. Figure 5 shows a 55-year-old woman with truncal obesity and skin excess. A no-drain lipoabdominoplasty with an extended incision allowed for circumferential truck liposuction and more excess skin excision. A rectus diastasis was also corrected.

Figure 6 demonstrates a 33-year-old woman who had a no-drain abdominoplasty for correction of a severe rectus diastasis repair. Per the patient’s request, no liposuction was performed.

CONCLUSIONS

Abdominoplasty continues to evolve and improve, but also is more complicated as aesthetic objectives become more demanding. New innovations can improve patient comfort, lower complications, and provide patients with greater satisfaction. As with other aesthetic procedures, proper patient assessment, risk stratification, and careful surgical execution are fundamental for optimal results.

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