

# 86. Abdominoplasty

Sacha I. Obaid  
Jason E. Leedy

## ANATOMY

### ■ The abdominal wall is composed of seven layers:

1. Skin
2. Subcutaneous fat
3. Scarpa's fascia (the superficial fascial system of the abdomen)
4. Subscarpal fat
5. Anterior rectus sheath
6. Muscle
7. Posterior rectus sheath

### SKIN

- The skin of the abdominal wall receives a rich vascular supply from multiple muscle and fascial perforating vessels.
- The skin of the abdominal wall can vary in quality depending on a person's genetics, age, previous pregnancies, and history of weight gain and loss.
- The skin of the abdominal wall may feature multiple **striae**, which are evidence of **attenuated or absent dermis**.

### FAT

- The abdominal wall has **two** layers of fat, **superficial and deep**, separated by Scarpa's fascia (Fig. 86-1).
  - The **superficial layer** of fat is thicker, denser, more durable, and has a heartier blood supply.
  - The **deeper layer** of fat is less dense and receives most of its blood from the subdermal plexus and the underlying musculocutaneous perforators.

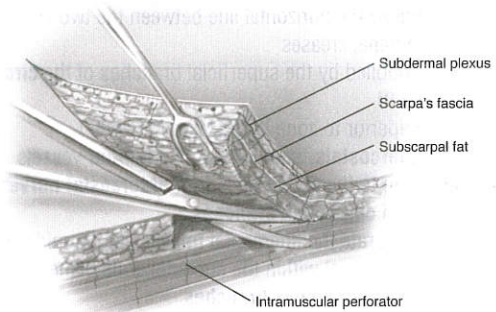


Fig. 86-1

**TIP:** Because the blood supply to the deeper fat is distinct from the blood supply to the skin, it can be more easily excised when attempting to thin the abdominal wall flap in an abdominoplasty. By contrast, thinning the superficial layer of fat may lead to vascular compromise of the overlying skin.

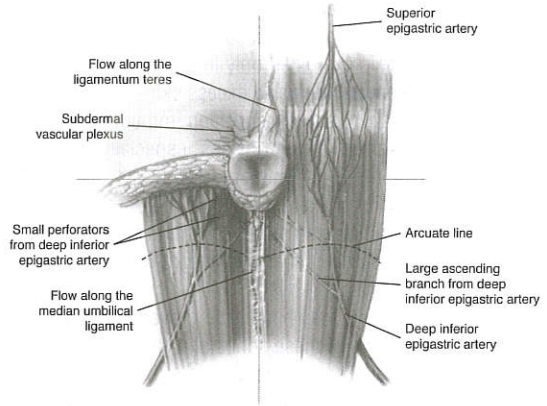
- There are **four paired muscle groups** of the abdominal wall.
  1. Rectus abdominis
  2. External oblique
  3. Internal oblique
  4. Transversalis abdominis
- The aponeurotic portions of the transversalis muscle and the two oblique muscles envelop the rectus abdominis muscles, forming the anterior and posterior rectus sheaths and meeting in the midline to form the linea alba.
- The **arcuate line** represents a transition point.
  - **Above the arcuate line**, there are distinct anterior and posterior rectus sheaths.
  - **Below the arcuate line**, contributions from the internal oblique and transversalis join contributions from the external and internal obliques to form a single anterior rectus sheath with no posterior rectus sheath.
  - The arcuate line lies roughly halfway between the umbilicus and the symphysis pubis.

### VASCULARITY OF THE ABDOMINAL WALL

- **Huger<sup>1</sup>** divided the vascular supply to the abdominal wall into **three zones**.
  - **Zone I**
    - ▶ Between the lateral borders of the rectus sheath from the costal margin to a horizontal line drawn between the two anterior superior iliac spines
    - ▶ Supplied primarily by superficial branches of the **superior and inferior epigastric systems**
  - **Zone II**
    - ▶ Below the horizontal line between the two anterior superior iliac spines to the pubic and inguinal creases
    - ▶ Supplied by the superficial branches of the **circumflex iliac** and **external pudendal vessels**
  - **Zone III**
    - ▶ Superior to zone II and lateral to zone I
    - ▶ **Intercostals, subcostals, and lumbar** vessels
- Sensation to the abdomen is from **intercostal nerves T7-12**.
  - **Lateral cutaneous branches**
    - ▶ Perforate the intercostal muscles at the midaxillary line
    - ▶ Then travel within the subcutaneous plane
  - **Anterior cutaneous branches**
    - ▶ Travel between the transverse and internal oblique muscles to penetrate the posterior rectus sheath just lateral to the rectus
    - ▶ Eventually enter the rectus muscles and then pass to the overlying fascia and skin

### UMBILICUS

- The umbilicus is located **on or near the midline at the level of the iliac crest**.
  - Only **1.7%** of patients have the umbilicus located exactly in the midline of the body.<sup>2</sup>
  - An **aesthetically pleasing umbilicus** has the following characteristics<sup>3</sup>:
    - ▶ Superior hooding
    - ▶ Inferior retraction
    - ▶ Round or ellipsoid shape
    - ▶ Shallow



**Fig. 86-2** Blood supply to the umbilicus.

- **Blood supply to the umbilicus** (Fig. 86-2) is from:
  - ▶ Subdermal plexus
  - ▶ Right and left deep inferior epigastric artery (DIEA)
  - ▶ Ligamentum teres
  - ▶ Median umbilical ligament

## PREOPERATIVE EVALUATION

### HISTORY AND PHYSICAL EXAMINATION

#### ■ Complete history should include<sup>3</sup>:

- Number of pregnancies and children
- Previous cesarean section or other abdominal surgery
- Previous or current hernias
- Exercise routine
- Gastrointestinal history including irritable bowel syndrome or constipation
- Respiratory history including asthma, smoking, or sleep apnea
- History of weight loss and gain, and active diet regimen

**TIP:** Abdominoplasty is a huge stressor in terms of blood supply to the abdominal wall flap. To minimize complications, avoid operating on active smokers. If a patient has a history of smoking, the plastic surgeon should insist that the patient quit smoking before the abdominoplasty and openly discuss the increased risk of complications. This will not only encourage cessation of smoking but also will help discourage patients from lying about their smoking history. A urine nicotine test may be indicated.

- Examine the skin of the abdominal wall for **striae**, which represent thinning or absent dermis.
  - The surgeon must explain to the patient that:
    - ▶ Striae located inferior to the umbilicus may be removed as part of the abdominoplasty
    - ▶ Most striae above the umbilicus will not be removed
    - ▶ Striae above the umbilicus may become more prominent, because the abdominal wall flap is stretched by the abdominoplasty

- The presence of **excess skin** must be assessed.
  - The patient must be examined while standing, supine, and sitting.
  - If the patient is examined only in the standing or supine position, the surgeon may be fooled into thinking there is little or no excess skin.
  - When the patient sits, the surgeon immediately notices if there is excess abdominal skin.
- Examine for **rashes or excoriations**, especially under the abdominal pannus in obese patients and massive-weight-loss patients.
- Look for **adhesions** where the skin and fat are tethered to deeper structures.
  - There is commonly an adhesion at that level at the waist.
  - In morbidly obese or massive-weight-loss patients there may be an additional adhesion or roll of skin superiorly.
  - These adhesions may hinder the movement of the abdominoplasty skin flap.
  - Surgical release of these adhesions can pose a risk of ischemia in the overlying skin flap.
  - Options for addressing the second adhesion are discontinuous undermining with either a liposuction cannula or Lockwood dissector, a *fleur-de-lis* abdominoplasty, or a second-stage reverse abdominoplasty.
- The **presence of scars** represents alterations to the blood supply of the abdominal wall.
  - **Upper midline scars** may limit inferior movement of the abdominal skin flap.
    - ▶ They may need to be treated with release at the time of abdominoplasty.
    - ▶ In some patients consideration may be given to a *fleur-de-lis* abdominoplasty.
  - **Subcostal scars** are particularly troubling.
    - ▶ They represent an interruption of the superolateral blood supply that the abdominoplasty skin flap relies on for blood supply postoperatively.
    - ▶ **Of all those undergoing abdominoplasty, these patients are at the highest risk for postoperative wound-healing complications.**

**CAUTION:** To prevent wound-healing complications, the abdominal wall skin flap *must not* be undermined beneath a subcostal incision. The limitations of undermining, limited results, and high risk of complications must be discussed with these patients. Many are not candidates for an abdominoplasty.

- Musculofascial laxity must be assessed.
  - A **diver's test** can be performed with the patient first standing and then flexing at the waist.
    - ▶ Worsening of lower abdominal wall fullness indicates **musculofascial laxity**.
  - An additional test for musculofascial laxity is the **pinch test**.
    - ▶ Abdominal fullness is assessed with the patient both relaxed and actively tensing the abdominal wall.
    - ▶ If the amount of fullness that can be pinched is significantly decreased by tensing the abdominal wall, then the patient has significant musculofascial laxity.
- Midline **diastasis recti abdominis** must be examined.

---

**TIP:** Nearly all patients who have previously been pregnant have some degree of musculofascial laxity of the abdominal wall in addition to excess skin.

---

- Examine and document any **hernias**, including incisional, epigastric, periumbilical, and inguinal hernias, especially in patients who have had previous surgeries and massive-weight-loss patients.

**NOTE:** The importance of a thorough hernia examination cannot be overstated. Preoperative knowledge of hernias can help the surgeon avoid injuring the bowel during dissection. In addition, depending on the size of the hernia and the comfort level of the plastic surgeon, preoperative knowledge of a hernia may allow the plastic surgeon to coordinate with a general surgeon to assist with hernia repair at the time of the operation.

### INFORMED CONSENT

- In addition to the standard risks of surgery, the plastic surgeon must discuss the location and the length of the scars with the patient.
  - The standard lower abdominal transverse scar
  - The potential need for a short vertical midline scar
    - ▶ This “T scar” may be necessary for patients with smaller amounts of excess abdominal wall skin and fat.
  - Potential for cutaneous deformities (“dog-ears”) at the lateral ends of the abdominoplasty incision.
    - ▶ If these are present, revisional surgeries, including excision of this skin or liposuction of the underlying fullness, may be necessary.
- Wound-healing complications must be discussed.
  - Both the transverse incision at the waist and the umbilicus itself are at risk for poor wound healing because of poor vascularity.
- Loss or malposition of the umbilicus must be discussed.
  - Patients should be reminded preoperatively that the umbilicus is truly midline in only 1.7% of patients.<sup>2</sup>
- The risk of postoperative seromas must be discussed.
  - The need for and purpose of postoperative drains should be explained.
- The potential need for revisional surgeries or procedures must be discussed.
- The surgeon must discuss financial arrangements and the patient’s responsibilities for these procedures.
- Patients must understand that they will not be able to walk fully erect for several days after the operation.
  - They will need a minimum of 2 weeks off from work.
  - They will not be able to do any strenuous exercise or lifting for at least 6 weeks postoperatively.
- The patient must be warned of the risk of **pulmonary embolism**.
  - Because of this risk, in addition to pneumatic devices, early ambulation is required.

### PROCEDURE SELECTION

- Patients with mild fat excess, no excess skin, and good skin tone are candidates for **liposuction alone**.<sup>4</sup>
- Patients with mild fat excess, no excess skin, good skin tone, and rectus diastasis should have **liposuction combined with endoscopic diastasis repair**.
- Patients with skin and fat excess isolated to the infraumbilical region should have an **infraumbilical miniabdominoplasty** with liposuction and diastasis repair.
- Patients with significant amounts of skin and fat excess not limited to the infraumbilical region should have a **traditional abdominoplasty** with or without liposuction of the flank.
- Patients with significant extra skin that may extend far laterally and even around to the back should have **circumferential abdominoplasty**.
  - This is the procedure of choice for most massive-weight-loss patients.

- Patients with excess skin at the lateral abdominal area, lateral hip and thigh, pubis, and possibly anteromedial thigh are candidates for **Lockwood's high lateral tension abdominoplasty**.
- Patients with excess skin both vertically and horizontally (especially in the upper midline region) are candidates for a **fleur-de-lis abdominoplasty**.

---

## TRADITIONAL ABDOMINOPLASTY

---

### PREOPERATIVE MARKINGS

- Patients should be encouraged to wear their undergarments of choice the day of surgery.
  - This helps the surgeon plan the lower incision with the goal of hiding as much of it under these garments as possible.
- Preoperative markings begin with identification of the pubic bone and the anterior superior iliac spine bilaterally.
- The planned incision should be marked beginning transversely at the level of the pubic bone.
  - At least **5 cm** must be left between this incision and the top of the vulval commissure to prevent distortion of the vulvar region postoperatively.
- The transverse marks are extended laterally and superiorly toward the hips bilaterally.
  - The lateralmost points of the incision should lie inferior to the anterior superior iliac spine (ASIS) to prevent visibility of the scar postoperatively.
- The surgeon should perform a pinch test to determine how much skin can be resected from the abdomen comfortably.
  - This pinch test is used to design a proposed upper incision.
  - The surgeon should determine whether the skin and fat all the way up to and just past the umbilicus should be excised in the operating room.
  - If there is any question, the surgeon must have a discussion with the patient about the high likelihood of needing a **small vertical component** to the incision with a final "inverted T"-shaped scar, which is more noticeable than the traditional transverse abdominoplasty scar.
- Areas to be considered for concomitant liposuction are marked preoperatively.

---

**TIP:** Most patients who present for abdominoplasty have at least some degree of fat excess in the hips, flanks, and/or thighs. These deposits frequently become more noticeable postoperatively. Both the surgeon and the patient must be aware of this and consider concomitant or staged liposuction with the abdominoplasty procedure for optimal results. Failure to recognize this and discuss it preoperatively may result in an unhappy patient with a compromised final result.

---

### PRINCIPLES

- Before the patient enters the operating room, the surgeon and the anaesthesiologist must **test the bed** to make sure it can flex at the patient's waist to an optimal level.

---

**TIP:** Failure to test the bed preoperatively can cause significant intraoperative difficulties.

---

- After induction of anaesthesia, liposuction should be performed in all planned areas.
- The abdominoplasty begins with placement of two traction sutures at 3 o'clock and 9 o'clock in the umbilicus.

---

**TIP:** Before making the circumumbilical incision, take care to place these sutures with asymmetrical tails; for instance, with one long tail and one short tail on the right and two long tails to this suture on the left to orient the umbilicus. This maneuver helps prevent twisting of the umbilical stalk during closure and subsequent poor blood flow.

---

- The umbilicus is incised circularly, and dissecting scissors are used to separate the umbilicus from the abdominal skin and fat all the way down to the rectus sheath.
    - Avoid skeletonizing the umbilical stalk, which leads to compromised vascularity of the umbilicus.
  - The inferior incision is made bilaterally.
  - Dissection is taken straight down to the fascia overlying the rectus and oblique musculature.
  - The skin and fat of the abdominal wall are elevated from the underlying muscular fascia in a loose areolar plane up to the costal margins laterally and to the xiphoid process medially.
  - Leave a small amount of fat on the muscular fascia in the region of the anterior superior iliac spine to prevent injury to the lateral femoral cutaneous nerve.
- 

**TIP:** The importance of leaving a small amount of fat on the muscular fascia in the region of the anterior superior iliac spine cannot be overemphasized. This prevents injury to the lateral femoral cutaneous nerve, which can cause significant pain, numbness, and dysesthesia in the hip and medial thigh region postoperatively. van Uchelen et al<sup>5</sup> found a 10% incidence of injury to this nerve in their review of abdominoplasty procedures.

---

**CAUTION:** As dissection is taken along the muscular fascia centrally, care must be taken to identify and preserve the umbilical stalk. Failure to do so results in transection of the umbilical blood supply and likely umbilical necrosis postoperatively.

---

**TIP:** Remember that there are a number of periumbilical musculocutaneous perforating vessels. These periumbilical perforators should signal the surgeon to slow the dissection and search for the umbilical stalk to prevent transection.

---

- Once the abdominal flap is elevated, the rectus diastasis is repaired.
    - A cotton-tipped applicator is used to apply methylene blue to the rectus sheath elliptically as a proposed area to be imbricated.
    - The rectus sheath is imbricated or reinforced by placing interrupted sutures along the marked repair.
    - Rectus plication helps narrow the waist and correct laxity in the abdominal wall that occurs in all women who have been pregnant.
  - After a first row of interrupted permanent sutures is placed, a second reinforcing permanent suture can be run from the xiphoid to the umbilicus, and a separate reinforcing suture can be run infraumbilically to the pubis.
- 

**TIP:** It is essential to begin rectus plication just inferior to the xiphoid process. Failure to do so can result in a postoperative bulge that is fairly distressing to the patient.

---

**■ Rectus plication** must be performed using **permanent sutures**.

- Using ultrasound imaging, van Uchelen et al<sup>5</sup> revealed a 40% recurrence rate for diastasis in 40 patients at 64 months when plication had been performed using absorbable sutures.
- Nahas et al<sup>6-8</sup> revealed a 0% recurrence rate for diastasis in 12 patients by CT scans at 76-84 months when permanent sutures were used.

**TIP:** Plication of the rectus fascia tends to be the most painful portion of the operation. Local anaesthetic delivered by continuous-infusion catheters to the region of the rectus plication can significantly reduce postoperative pain.

---

- If used, Jackson-Pratt drains should be brought out through the hair-bearing skin of the pubic region.
- The bed is flexed, bringing the patient to a seated position, and the amount of skin and fat that can be resected from the abdominal wall while allowing a tension-free closure is marked.
- This excess skin and fat are resected.
- The wound is copiously irrigated.
- The level of the umbilicus is transposed with a marking pen to the overlying skin of the abdominal wall.
- The umbilicus is inset.
- The superficial fascial system is closed, followed by closure of the deep dermal and subcuticular layers.
- An abdominal binder is placed postoperatively.

---

### **MINIABDOMINOPLASTY<sup>3</sup>**

---

- The miniabdominoplasty is useful for patients with primarily **infraumbilical excess of skin and fat**.
- A **shorter scar** is planned than for a traditional abdominoplasty.
  - The scar should be **12-16 cm long**.
- Rather than separating the umbilicus from the abdominal wall flap, it **remains attached**.
- The umbilical stalk is transected at the level of the anterior abdominal wall fascia.
- The resulting umbilical fascial defect is repaired.
- The rectus diastasis is repaired using permanent sutures.
- A more conservative skin and fat resection is performed than for a traditional abdominoplasty.
  - The umbilicus is usually moved approximately 2 cm inferiorly with this procedure.
- Liposuction is frequently added to this procedure to further improve abdominal contour, especially in the supraumbilical region.

---

### **HIGH-LATERAL-TENSION ABDOMINOPLASTY<sup>9</sup>**

---

- One basis for this procedure lies in the fact that although the excess skin infraumbilically is primarily **vertical**, the excess skin in the epigastrium is primarily **horizontal**.
  - Lockwood<sup>9</sup> believes that the skin of the epigastrium develops laxity horizontally because of a strong superficial fascial adherence to the linea alba, which limits vertical descent of skin and fat.
  - Therefore less skin is taken centrally and more is taken laterally.
  - This results in an **oblique vector of pull** that addresses both the infraumbilical vertical excess and the epigastric lateral pull.



- The other theory that serves as a basis for this procedure is that direct undermining to the costal margins, which is a fundamental part of traditional abdominoplasty, is actually unnecessary.
  - **Direct undermining is performed only centrally** in an area that allows for rectus plication.
  - The limited direct undermining makes liposuction safer throughout a much larger area of the abdominal flap.
  - Liposuction superolaterally creates a discontinuous undermining, allowing for advancement of the abdominal flap.<sup>9</sup>
- The high-lateral-tension abdominoplasty also has the advantage of performing a lift of the anterior and lateral thighs.
- It also allows for liposculpture of the abdomen, leading to a more contoured result.<sup>9</sup>

### PREOPERATIVE MARKINGS

- Preoperative marking begins with a suprapubic mark 6.5 to 7.0 cm superior to the incisura of the vagina or the base of the penis.<sup>3</sup>
- The anterosuperior iliac spine is marked bilaterally, and the three marks are connected.
- The marking pen is then placed centrally at the inferior incision line, and the vertical excess of skin is pulled upward until taut. The skin that is now at the tip of the pen is marked.
- Potential excess skin is tested laterally using a pinch test.
- This excess is marked laterally and connected to the central mark.
- The resultant proposed upper incision should lie infraumbilically and superior to the umbilicus laterally.
- The proposed areas of liposuction are marked both centrally and laterally.

### PRINCIPLES

- Create the lower incision and elevate the skin and fat of the rectus fascia centrally just enough to perform rectus plication.
- Rectus plication is performed.
- Laterally the abdominal skin flap remains connected to the underlying rectus fascia, but it is loosened by discontinuous undermining using vertical spreading or Mayo scissors, the surgeon's finger, an oversized suction cannula, or a Lockwood Underminer Cannula (Byron Medical, Inc, Tucson, AZ).<sup>3</sup>
- The amount of skin and fat that can be resected centrally and laterally is confirmed using a pinch test or a Lockwood Abdominal Demarcator (Integra NeuroSciences, Plainsboro, NJ).
  - Remember that with this technique, more skin and fat should be resected laterally than centrally.
- Depending on the amount of infraumbilical skin to be excised, the umbilicus can be left in place and pulled inferiorly, or the stalk can be transected and the umbilicus floated, or it can be excised and relocated.
- The wound is tacked closed, and liposuction is performed in both a superficial and deep plane.
- Drains are placed.
- The superficial fascial system is repaired, followed by closure of the deep dermis and the skin.

---

### FLEUR-DE-LIS ABDOMINOPLASTY<sup>10</sup>

---

- The **fleur-de-lis** technique allows for excision of the lower abdominal excess skin and fat through a transverse incision.
- It allows for simultaneous removal of the supraumbilical horizontal skin excess through a vertical excision.

- The abdominoplasty can be taken as high as the xiphoid in the midline and as low as the mons pubis, depending on the area of skin laxity.
- The key to the skin flaps surviving is to leave them attached to the underlying fascia, except in the areas contained within the fleur-de-lis excision, to maximize vascularity.<sup>3</sup>
- Although this procedure can completely change the abdominal contour, the expected scars must be discussed preoperatively because they can be significant.

---

## REVERSE ABDOMINOPLASTY

---

- Reverse abdominoplasty was first described in the American literature by Baroudi et al<sup>11</sup> in 1979.
- A transverse upper abdominal incision is made roughly at the level of the inframammary fold, and redundant superior abdominal tissue is pulled up to meet this incision and excised.
- The principal indication is for cleanup of residual redundant tissue left behind superiorly after lower abdominoplasty.
- The other indication is the rare patient who presents with excess skin and abdominal protuberance that is primarily in the upper pole of the abdomen.<sup>3</sup>
- The reverse abdominoplasty can be combined with a breast procedure (e.g., a Wise pattern reduction or mastopexy) because the inframammary fold incisions can be used for both procedures.

### KEY POINTS

- ✓ Successful rejuvenation of the abdomen requires a thorough understanding of the anatomy of the abdominal wall and the techniques available for rejuvenation.
- ✓ The selection of a procedure is of paramount importance for obtaining a good result.
- ✓ A graduated approach should be taken for liposuction performed in patients with minimal to moderate excess fat and good skin tone or quality with little laxity. Patients with more excess skin and fat are better candidates for a traditional abdominoplasty.
- ✓ During abdominoplasty, care must be taken to preserve the lateral femoral cutaneous nerve to prevent painful postoperative neuromas.
- ✓ Permanent sutures must be used during rectus plication to prevent recurrent rectus diastasis.
- ✓ Newer techniques have been developed, including the fleur-de-lis abdominoplasty and the high-lateral-tension abdominoplasty, to address supraumbilical horizontal abdominal laxity in some patients in addition to vertical infraumbilical abdominal laxity.

---

### REFERENCES

1. Huger WE Jr. The anatomic rationale for abdominal lipectomy. *Am Surg* 45:612-617, 1979.
2. Rohrich RJ, Sorokin ES, Brown SA, et al. Is the umbilicus truly midline? Clinical and medicolegal implications. *Plast Reconstr Surg* 112:259-265, 2003.
3. Nahai F. *The Art of Aesthetic Surgery: Principles and Techniques*. St Louis: Quality Medical Publishing, 2005.
4. Rohrich RJ, Beran SJ, Kenkel JM, et al. Extending the role of liposuction in body contouring with ultrasound-assisted liposuction. *Plast Reconstr Surg* 101:1090-1102, 1998.

5. van Uchelen JH, Kon M, Werker PM. The long-term durability of plication of the anterior rectus sheath assessed by ultrasonography. *Plast Reconstr Surg* 107:1578-1584, 2001.
6. Nahas FX, Augusto SM, Ghelfond C. Should diastasis recti be corrected? *Aesthetic Plast Surg* 21:285-289, 1997.
7. Nahas FX, Ferreira LM, Mendes Jde A. An efficient way to correct recurrent rectus diastasis. *Aesthetic Plast Surg* 28:189-196, 2004.
8. Nahas FX, Ferreira LM, Augusto SM, et al. Long-term follow-up of correction of rectus diastasis. *Plast Reconstr Surg* 115:1736-1743, 2005.
9. Lockwood T. High-lateral-tension abdominoplasty with superficial fascial system suspension. *Plast Reconstr Surg* 96:603-615, 1995.
10. Dellon AL. Fleur-de-lis abdominoplasty. *Aesthetic Plast Surg* 9:27-32, 1985.
11. Baroudi R, Keppke EM, Carvalho CG. Mammary reduction combined with reverse abdominoplasty. *Ann Plast Surg* 2:368-373, 1979.