Melvin A. Shiffman
Sid Mirrafati
Editors

Aesthetic Surgery of the Abdominal Wall

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Melvin A. Shiffman · Sid Mirrafati (Eds.)

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With 212 Figures in 398 Parts and 36 Tables

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Melvin A. Shiffman, MD, JD
Sid Mirrafati, MD
Mira Aesthetic Medical Center
1101 Bryan Avenue, Suite G
Tustin, CA 92780, USA

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Introduction

We have come a long way since the days when abdominal wall contouring was performed by simple dermolipectomies, with no attention to diastasis correction and muscular reinforcement, and little regard for the final aesthetic result. Nowadays, an abdominoplasty may be indicated for even the most demanding of patients. Details such as placement of the incision and umbilicoplasty are meticulously planned so as to conceal undesirable scars. Since the advent of suction-assisted lipectomy, in association with a classical operation or as an isolated procedure, the plastic surgeon has become capable of remodeling the entire trunk, assuring removal of considerable amounts of adipose tissue. Drs. Shiffman and Mirrafati have brought all of these aspects together, in this most timely book, *Aesthetic Surgery of the Abdominal Wall*. Here the reader will find an all-encompassing textbook, written in collaboration with outstanding colleagues, all of whom have contributed to this field of plastic surgery that has been of particular interest to me. I am sure that, for both the younger and the more experienced surgeon, this book will become a reference text, covering all aspects of plastic abdominal surgery.

Ivo Pitanguy, MD

Preface

This book on aesthetic surgery of the abdominal wall is an attempt to bring together the existing knowledge on body contouring of the abdomen. The major emphasis is on abdominoplasty and liposuction of the abdomen with the various combinations and techniques. Of course, not all the variety of procedures can be covered, but the information made available will be valuable to the novice and the experienced abdominal wall surgeon alike.

Personal techniques are described and information is given on the avoidance and treatment of complications. This is especially valuable in our present litigious society where awareness of the standards of care and informed consent are so essential. The chapter on medical legal aspects shows what can go wrong and discusses why the problems occurred and methods for avoiding these situations. The chapter on guidelines for the prevention of thromboembolism gives insights into how to prevent this problem, especially in the moderate risk patient, the type that is so common in cosmetic surgery. There is nothing more essential than the safety of the patient in a field where surgery is elective and for beautifying rather than the correction of a disease, defect, or disorder.

The hope is that surgeons can learn the proper techniques for performing aesthetic surgery on the abdominal wall with the greatest safety by understanding the techniques and pitfalls of the procedures and their complications.

Melvin A. Shiffman, MD, JD
Sid Mirrafati, MD

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List of Contributors

John Anastasatos, MD (e-mail: jobe.fix@ccc.uab.edu)
Division of Plastic and Reconstructive Surgery, 1813 6th Avenue South (524MEB), Birmingham, AL 35294-3295, USA

Orhan E. Arslan, PhD (e-mail: arslano2003@yahoo.com)
Department of Cell Biology and Anatomy, The Chicago Medical School, Rosalind Franklin University of Medicine and Science
3333 Greenbay Road, North Chicago, IL 60064, USA

Gary D. Bennett, MD (e-mail: dasseen@cox.net)
7 Pelican Hill Circle, Newport Coast, CA 92657, USA

Lazaro Cardenas Camarena, MD (e-mail: plassurg@mail.udg.mx)
Plastic Surgery Unit, Av. Chapalita 1300 Col. Chapalita, Guadalajara, Jallisco 4500, Mexico

Jacques Faivre, MD (e-mail: drjacquesfaivre@noos.fr)
Chirurgie Plastique et Esthetique, 23, rue Vital, 75116 Paris, France

Jean-Marie Faivre, MD (e-mail: drjacquesfaivre@noos.fr)
Chirurgie Plastique et Esthetique, 23, rue Vital, 75116 Paris, France

Giorgio Fischer, MD (e-mail: giorgiofischer@flashnet.it)
Via della Camilluccia, 643-00135 Rome, Italy

R. Jobe Fix, MD (e-mail: jobe.fix@ccc.uab.edu)
Division of Plastic and Reconstructive Surgery, 1813 6th Avenue South (524MEB), Birmingham, AL 35294-3295, USA

Pierre Fournier, MD (e-mail: pierre.fournier27@wanadoo.fr)
55, Boulevard De Strasbourg 75010, Paris, France

Anjum Khan, BA (e-mail: khan_anjum@yahoo.com)
St. George's University, Grenada, West Indies

Bruce A. Mast, MD (e-mail: bmast@accentphysicianspecialists.com)
4340 Newberry Rd., Gainsville, FL 32607, USA

Alan Matarasso, MD (e-mail: matarasso@aol.com)
Albert Einstein College of Medicine, New York, NY, USA

Sid Mirrafati, MD (e-mail: drmirrafati@youngerlook.com)
Mira Aesthetic Medical Center, 1101 Bryan Avenue, Suite G, Tustin, CA 92780, USA

Chiraz Moheli, MD (e-mail: drjacquesfaivre@noos.fr)
Chirurgie Plastique et Esthetique, 23, rue Vital, 75116 Paris, France

Richard Moufarrège, MD (e-mail: plasticsurg_moufar@hotmail.com)
1111, rue St-Urbain, Suite 106, Montreal (Quebec), H2Z 1Y6, Canada

Timothy D. Parish, MD
Varicosis & Laser Center of Alabama, 3055 Lorna Road, Suite 210, Hoover, AL 35216, USA

Ivo Pitanguy, MD (e-mail: Pitanguy@visualnet.com.br)
Rua Dona Mariana, 65, 2280-020 Rio de Janeiro, Brazil

Henrique N. Radwanski, MD
Pontifical Catholic University, Rio de Janeiro (PUC-Rio) and Carlos Chagas Institute of Postgraduate Medical Studies, Rio de Janeiro, Brazil

Oscar Ramirez, MD (e-mail: oscar@ramirezmd.com)
2219 York Road, Suite 100, Timonium, MD 21093, USA

Keith M. Robertson, MD (e-mail: plasticsurgery@hotmail.com)
Esthetique Internationale and Suburban Hospital, Chevy Chase, MD 20814, USA

Melvin A. Shiffman, MD, JD (e-mail: shiffmanmdjd@comcast.net)
1101 Bryan Ave., Suite G, Tustin, CA 92780, USA

Luiz S. Toledo, MD (e-mail: lstoledo@netpoint.com.br)
Av. Brig. Luiz Antonio 4225, 01401-002 San Pablo, Brazil

Steven G. Wallach, MD (e-mail: Sgwallach@aol.com)
1049th Avenue, Suite 2D, New York, NY 10028, USA

Mark L. Zukowski, MD (e-mail: anewyou@elnet.com)
3612 Lake Avenue, Wilmette, IL 60091, USA

Anatomy of the Abdominal Wall

1

Orhan E. Arslan

1.1 Introduction

The abdominal wall encompasses an area of the body bounded superiorly by the xiphoid process and costal arch, and inferiorly by the inguinal ligament, pubic bones and the iliac crest.

Visualization, palpation, percussion, and auscultation of the anterolateral abdominal wall may reveal abnormalities associated with abdominal organs, such as the liver, spleen, stomach, abdominal aorta, pancreas and appendix, as well as thoracic and pelvic organs. Visible or palpable deformities such as swelling and scars, pain and tenderness may reflect disease processes in the abdominal cavity or elsewhere. Pleural irritation as a result of pleurisy or dislocation of the ribs may result in pain that radiates to the anterior abdomen. Pain from a diseased abdominal organ may refer to the anterolateral abdomen and other parts of the body, e.g., cholecystitis produces pain in the shoulder area as well as the right hypochondriac region. The abdominal wall should be suspected as the source of the pain in individuals who exhibit chronic and unremitting pain with minimal or no relationship to gastrointestinal function, but which shows variation with changes of posture [1]. This is also true when the anterior abdominal wall tenderness is unchanged or exacerbated upon contraction of the abdominal muscles (positive Carnett's sign). Abdominal wall pain can be the result of localized endometriosis, rectus sheath hematoma, or abdominal incision or hernia.

1.2 Regions of the Abdominal Wall

To accurately describe the locations of visible abnormalities, masses, and pain in a typical clinical write-up, the anterolateral abdomen is divided into nine regions by four imaginary planes: two verticals (midclavicular/midinguinal) and two horizontal (transpyloric/intertubercular) planes (Fig. 1.1). The transpyloric plane corresponds to the midpoint between the umbilicus and xiphoid process, crossing the pylorus of the stomach at

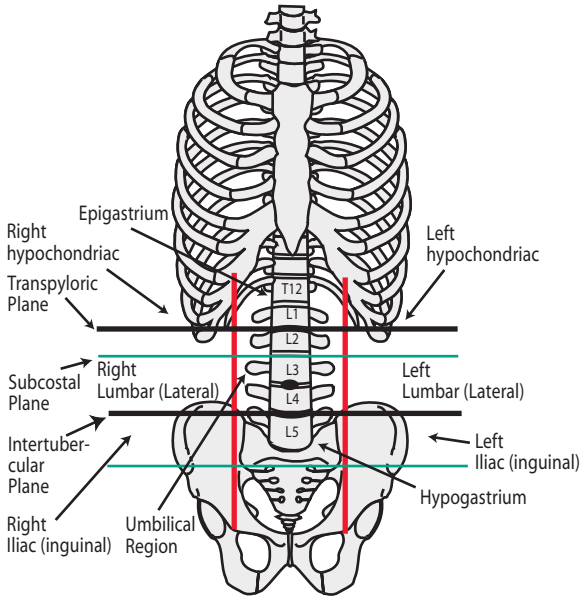


Fig. 1.1. Various regions of the anterior abdominal wall

the lower border of the first lumbar vertebra. The subcostal plane that passes across the costal margins and the upper border of the third lumbar vertebra may be used instead of the transpyloric plane. The lower horizontal plane, designated as the intertubercular line, traverses the anterior abdomen at the level of fifth lumbar vertebra, and connects the iliac tubercles on both sides. A second lower horizontal plane, the interspinous plane, may also be used, interconnecting the anterior superior iliac spines on both sides and running across the sacral promontory. Of the nine areas, the centrally placed zone is the umbilical region. This region surrounds the umbilicus and usually corresponds to the location of the jejunum, transverse part of the duodenum, terminal ileum, transverse colon, ureter and the greater curvature of the stomach.

The epigastrium is the upper middle part of the anterior abdomen between the umbilicus below and the costal arches and the xiphoid process above. It contains the stomach, left lobe of the liver, and part of the pancreatic head. The pubic region known as the hypogastrium de-

fines the zone immediately distal to the umbilical region and contains the ileum and sigmoid colon. The hypochondriac regions flank the epigastrium and are occupied on the right side by the liver, gallbladder, right colic flexure, descending duodenum, right kidney and suprarenal gland. On the left side these regions contain the spleen, left kidney and suprarenal gland, tail of the pancreas, left colic flexure, and fundus of the stomach. Most of the hypochondriac and parts of the epigastric regions are protected by the lower ribs. Areas immediately to the right and left of the umbilical region are designated as the right and left lumbar (lateral) regions, containing the ascending and descending colon, respectively. The right and left iliac regions surround the hypogastrium. The right iliac region contains the appendix and cecum, and the left iliac region corresponds to locations of the sigmoid colon and left ureter.

A simplified division of the anterolateral abdomen uses two imaginary planes that run through the umbilicus, one passing horizontally and the other vertically. The four quadrants separated by these planes divide the anterior abdomen into the right and left upper and lower quadrants.

In summary, the regions described above help medical practitioners to accurately describe the pathological processes associated with the anterior abdominal wall and to document the findings in the differential diagnosis. For example, periumbilical and hypogastric pain is felt during the initial stage of appendicitis, while pain in the right iliac region occurs at a later phase in this condition. Pancreatic or esophageal disorders produce pain that projects to the epigastrium.

1.3 Layers of the Abdominal Wall

The anterolateral abdominal wall consists, from the outside in, of the skin, superficial fascia, deep fascia, external and internal abdominal oblique, transverse abdominis and associated aponeuroses, rectus abdominis and pyramidalis, as well as the transversalis fascia.

1.3.1 Skin

The skin is of average thickness, and loosely attaches to the underlying tissue. It exhibits certain surface markings such as the umbilicus, linea alba, linea semilunaris, epigastric fossa, and McBurney's point.

The umbilicus, a midline fibrous cicatrix covered by a folded area of skin, is an important anatomical landmark in the anterior abdomen that marks the original attachment of the fetal umbilical cord. In young adults, it is usually located at the level of the intervertebral disc between the third and fourth vertebrae. However, lower levels are observed in obese individuals and in conditions that reduce abdominal tone. In the fetus, the umbilicus transmits the vitelline and umbilical vessels and yolk stalk.

The umbilicus can be the site of an acquired umbilical hernia or omphalocele [2, 3]. It is surrounded by the paraumbilical veins that establish connections with both the portal vein and the inferior vena cava (portacaval anastomosis) through a series of venous channels. It is also the site of attachment of the umbilical ligaments that consist of the median umbilical (remnant of the urachus), medial umbilical (obliterated umbilical arteries) and lateral umbilical (inferior epigastric vessels) ligaments/folds. A patent urachus may discharge urine because of its connection to the urinary bladder, and it can be associated with outflow obstruction or pus from an infected urachal cyst or with fecal matter if it is connected to part of the large intestine.

The umbilicus may also receive the embryological remnant of the vitelline duct known as Meckel's diverticulum. This diverticulum occasionally protrudes through the anterolateral abdomen and produces Littre's hernia. The umbilicus also receives the round ligament of the liver, a remnant of the umbilical vein. The umbilical vein remains patent for some time during early infancy and allows blood transfusion through catheterization in individuals with hemolytic diseases such as erythroblastosis fetalis [4].

The superficial abdominal reflex refers to deviation of the umbilicus toward the stimulated side when the skin of the anterolateral abdomen is stimulated by a blunt object applied to the flank at the midaxillary line inward toward the umbilicus. This reflex, which involves contraction of the abdominal muscles and subsequent deviation of the umbilicus, reveals the condition of the ninth through the eleventh spinal cord segments. Disappearance of this reflex is associated with postoperative pain following thoracotomy [5]. Absence of this reflex can be an early sign of syringomyelia in individuals with scoliosis [6, 7].

The linea alba (white line) is formed by the midline fusion of the aponeuroses of flat abdominal muscles and may be visible through the skin of muscular individuals. The linea semilunaris (Spigelian line) marks the lateral border of the rectus abdominis, extending from the costal arch near the ninth costal cartilage to the pubic tubercle. This line marks the sites of entry of motor nerves to the rectus abdominis, rendering it a surgically undesirable site for incisions. Spigelian hernia, which consists of extraperitoneal fat covered by the skin, superficial fascia and the aponeurosis of the external oblique, may be hidden at the junction of the linea semilunaris and arcuate line of Douglas. The small depression below the infrasternal angle is termed the epigastric fossa. McBurney's point marks the junction of

the lateral and middle third of a line that connects the anterior superior iliac spine to the pubic tubercle. This topographic landmark on the anterior abdomen corresponds to the common location of the appendix.

The horizontal directions of the connective tissue fibers beneath the epidermis form the visible Langer's cleavage lines. Due to the elastic quality of the connective tissue, an incision will produce retraction of the connective tissue and eventual gapping of the skin. An incision made perpendicular to the direction of Langer's lines is most likely to gape and result in prominent scarring. Since the course of the nerves and vessels that supply the anterolateral abdomen parallels the cleavage lines of the skin, transverse incisions of the abdomen are surgically more favorable. They are less likely to gape or cause damage to nerves or vasculature and heal faster without visible scarring. The dermis of the skin of the anterolateral abdomen is resilient, permits some degree of stretch, and is able to counteract the prolonged tearing pressure. However, stretch exerted by the pregnant uterus can disrupt the connective tissue fibers of the dermis and produce striae perpendicular to the Langer's lines, commonly known as 'stretch marks'.

1.3.2 Superficial Fascia

The superficial fascia (Fig. 1.2) is a soft and movable layer, which comprises, to a great extent, a single variably fatty superficial layer known as Camper's fascia. The amount of fat in Camper's fascia varies depending on the nutritional status of the individual. In the male, it continues inferiorly with the dartos layer of the scrotum and outer layer of the penis and spermatic cord, where it becomes thinner, lacking adipose tissue. In the female, it continues with the superficial fascia covering the labia majora. Approximation of Camper's fascia at closure of the abdominal incision during cesarean delivery appears to prevent postoperative superficial wound disruption [8].

In the lower wall of the anterior abdomen, a deeper membranous layer known as Scarpa's fascia becomes visible [9]. This layer remains connected, though loosely, to the deep fascia that covers the aponeurosis of the external abdominal oblique muscle. The strength of the Scarpa's fascia can stabilize sutures placed when closing incisions of the abdominal wall. The space between the deep fascia that covers the external oblique and Scarpa's fascia (superficial inguinal pouch) occupied by loose connective tissue may serve as a frequent site for retracted ectopic testis in children.

Scarpa's fascia (Fig. 1.2) firmly attaches to the linea alba and symphysis pubis and forms the fundiform ligament of the penis or the clitoris. In the male, it joins the Camper's fascia and continues into the scrotum as a single smooth muscle containing a layer known as the dartos. This deep and tough collagenous layer is continuous with Colle's fascia of the perineum, and with the inferior wall of the superficial perineal pouch or recess. In the upper thigh, it is attached to the fascia lata

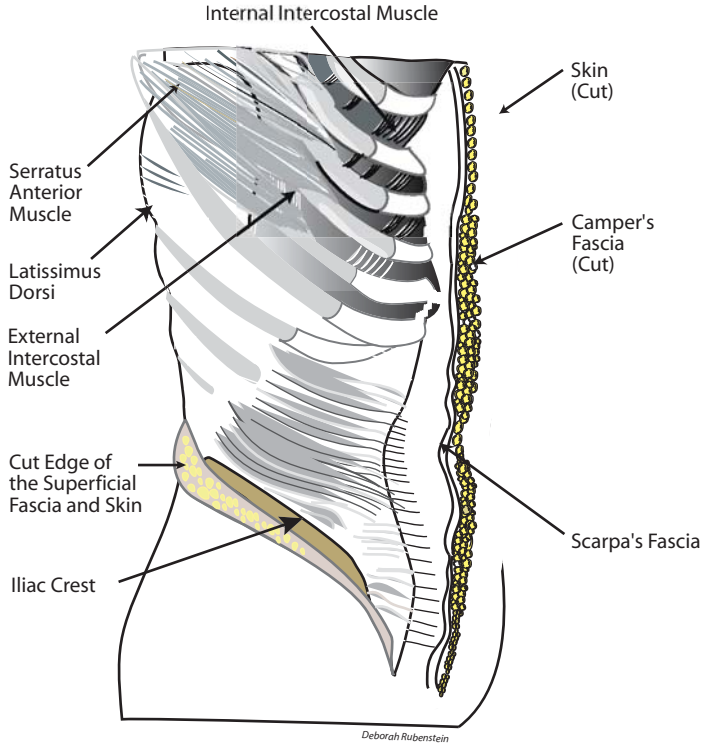


Fig. 1.2. The two layers of the superficial fascia of the abdominal wall

just below and parallel to the inguinal ligament. Since the superficial perineal pouch contains the urethra, rupture of the urethra may result in extravasation of blood and urine into the superficial perineal pouch. Accumulated blood and urine in this pouch may extend into the anterior abdominal wall between Scarpa's fascia and the deep fascia covering the external oblique. Because of the firm attachment of Scarpa's fascia to the fascia lata, inferior spread of fluid is not possible. The space between the two layers of the superficial fascia allows passage of the cutaneous vessels, nerves and lymphatics of the superficial inguinal nodes.

1.4 Blood Supply of the Abdominal Wall

The abdominal wall receives blood supply through branches of the femoral, external iliac, subclavian and intercostal arteries as well as the abdominal aorta (Fig. 1.3). These branches include the superficial epigastric, superficial circumflex iliac, superficial external pudendal, deep circumflex iliac, superior and inferior epigastric, posterior intercostal, subcostal, musculophrenic, and lumbar arteries [10].

1.4.1 Superficial Epigastric Artery

The superficial epigastric artery is a branch of the femoral artery distal to the inguinal ligament that ascends in the superficial fascia of the abdomen toward the umbilicus. This vessel provides the blood supply to the superficial fascia and skin of the abdomen, anastomosing with the inferior epigastric artery [10].

1.4.2 Superficial Circumflex Iliac Artery

The superficial circumflex iliac artery arises from the femoral artery near the origin of the superficial epigastric artery. It pierces the deep fascia of the thigh lateral to the saphenous opening and courses laterally toward the anterior superior iliac spine to supply the superficial fascia and skin. It is considered the smallest branch of the femoral artery that anastomoses with the deep circumflex iliac, lateral femoral circumflex iliac and superior gluteal arteries. The course of this vessel, an important structure in a groin flap, can best be localized by palpation of the anterior superior iliac spine and the pubic tubercle through the skin of the inguinal region [11].

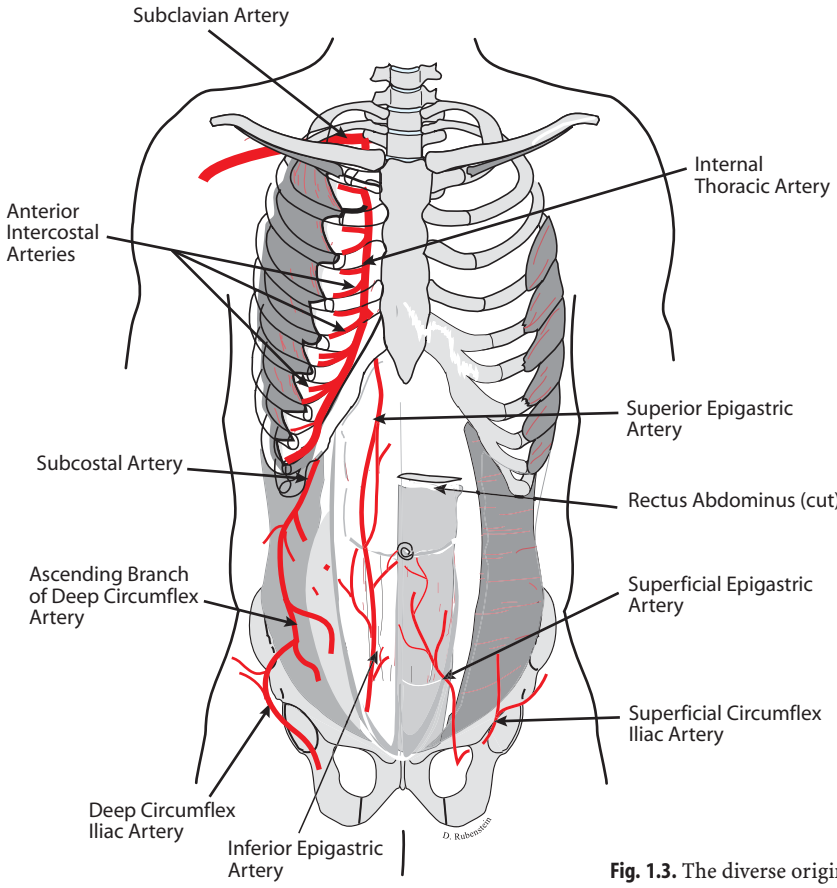


Fig. 1.3. The diverse origin of the arterial supply to the abdomen

1.4.3 Superficial External Pudendal Artery

The superficial external pudendal artery branches off the femoral artery and runs medially deep to the great saphenous vein. It travels across the spermatic cord (round ligament) to supply the lower anterior wall of the abdomen.

1.4.4 Deep Circumflex Iliac Artery

The deep circumflex iliac artery originates from the external iliac artery lateral to the point of origin of the inferior epigastric artery and advances laterally posterior to the inguinal ligament in a sheath formed by the transversalis and iliac fascia. After it pierces the transverse abdominis and enters the area between this muscle and the internal oblique muscle, it anastomoses with the iliolumbar, superior gluteal, lumbar, and inferior epigastric arteries.

1.4.5 Superior Epigastric Artery

The superior epigastric artery (Fig. 1.3), one of the terminal branches of the internal thoracic artery, arises at the level of the sixth costal cartilage, descends anterior to the transversus thoracis, and continues into the sternocostal triangle of Morgagni. The latter is a gap between the costal and sternal attachments of the diaphragm. It then enters the posterior layer of the rectus sheath at the middle of the xiphoid process and the anterior sheath at the middle of the upper third of the upper abdomen and supplies the rectus abdominis, diaphragm and the skin of the abdomen [12]. This vessel establishes linkage with the inferior epigastric artery and with the hepatic arteries through the falciform ligament. The arterial anastomosis between the superior and inferior epigastric arteries provides important collateral circulation to the lower part of the body in individuals with postductal coarctation.

1.4.6 Inferior Epigastric Artery

The inferior epigastric artery (Fig. 1.3) is a branch of the external iliac artery that ascends obliquely along the medial margin of the deep inguinal ring, posterior to the spermatic or round ligament. It may arise from the femoral artery, or, very rarely from the obturator artery. It pierces the transversalis fascia to enter into the posterior wall of the rectus abdominis at the level of the arcuate line. This vessel penetrates the posterior sheath near the middle of the lower abdomen and the anterior sheath in an area ranging from the upper third of the lower abdomen to the umbilicus. The arterial anastomosis between the inferior and superior epigastric arteries and the posterior intercostal arteries at the lower third of the upper abdomen allows collateral circulation to develop with the internal thoracic artery upon obstruction or ligation of the common or external iliac artery. This arterial anastomosis is also significant in the planning and implementation of vertical fasciocutaneous flaps of the abdominal wall [12]. After giving rise to the pubic, cremasteric and cutaneous branches, the inferior epigastric artery ascends under the parietal peritoneum as the lateral (epigastric) umbilical fold.

The cremasteric branch of the inferior epigastric artery supplies the cremasteric muscle and other coverings of the spermatic cord as well as the testis through its anastomosis with the testicular artery. In the female, it provides blood supply to the round ligament. The pubic branch descends posterior to the pubis, supplies the parietal peritoneum and anterior abdominal muscles, forming an anastomosis with branches of the lumbar, circumflex iliac, and the obturator arteries. In one-third of individuals, the pubic branch may be replaced by the obturator artery. The pubic branch forms an anastomosis with and supplies the parietal peritoneum and anterior abdominal muscles. The cutaneous branches establish anastomoses with the superficial epigastric artery and supply the skin of the lower abdomen and the adjacent part of the aponeurosis of the external abdominal oblique.

1.4.7 Posterior Intercostal Arteries

The lower two or three posterior intercostal arteries cross the corresponding intercostal space into the costal groove proximal to the costal angle. At this location they lie between the intercostal vein (above) and intercostal nerve (below), continuing into the anterior abdomen with the subcostal, superior epigastric and lumbar arteries. The posterior intercostal arteries enter the rectus sheath from its lateral border, anastomosing with the superior and inferior epigastric arteries.

1.4.8 Subcostal Artery

The subcostal artery courses inferior to the last rib and anterior to the 12th thoracic vertebra. It lies posterior to the sympathetic trunk, thoracic duct, pleura and diaphragm. Then, it descends into the posterior abdominal wall posterior to the lateral arcuate ligament accompanied by the corresponding vein and nerve. As it continues anterior to the quadratus lumborum and posterior to the kidney, the right subcostal artery courses behind the ascending colon, whereas the left subcostal artery travels behind the descending colon.

The subcostal artery establishes anastomoses with the lower posterior intercostal, superior epigastric and lumbar arteries.

1.4.9 Musculophrenic Artery

The musculophrenic artery, a terminal branch of the internal thoracic artery, runs inferiorly and laterally posterior to the seventh to ninth costal cartilages and gives rise to the lower two anterior intercostal arteries to the corresponding intercostal spaces. It supplies the pericardium and anterior abdominal muscles, anastomosing with the deep circumflex iliac and the lower two posterior intercostal arteries.

1.4.10 Lumbar Arteries

The lumbar arteries arise from the abdominal aorta anterior and to the left of the lumbar vertebrae. A fifth pair of lumbar arteries may arise from the middle sacral artery. They run posterior to the sympathetic trunk and the tendinous origins of the psoas major muscle. On the right side they travel posterior to the inferior vena cava but only the upper two pairs of lumbar arteries course posterior to the corresponding crus of the diaphragm. The upper three pairs run anterior, while the lowest course runs posterior, to the quadratus lumborum. After they pierce the transverse abdominis, running between this muscle and the internal oblique, the lumbar arteries anastomose with the iliolumbar, subcostal, deep circumflex, inferior epigastric and lower posterior intercostal arteries. Spinal branches of the lumbar arteries supply the conus medullaris, cauda equina, and spinal meninges.

1.5 Venous Drainage of the Anterolateral Abdomen

The anterior abdominal wall is drained via the superficial epigastric, thoracoepigastric, paraumbilical and the superficial circumflex iliac veins (Fig. 1.4).

1.5.1 Superficial Epigastric Vein

The superficial epigastric vein drains the inferior part of the anterior abdominal wall and is connected to the paraumbilical and thoracoepigastric veins. This vessel drains via the great saphenous vein into the femoral, external iliac and common iliac veins and eventually into the inferior vena cava. It also drains into the portal vein through the paraumbilical veins and the partially obliterated umbilical vein. Through this venous linkage to both the inferior vena cava and portal vein, a portacaval anastomosis is established. Occlusion of the por-

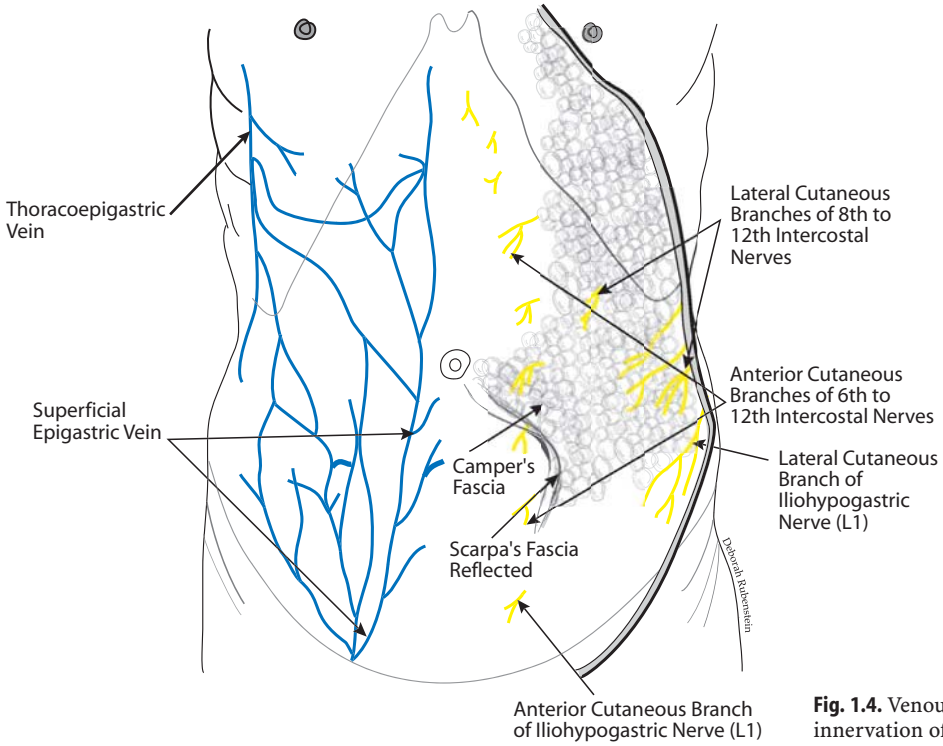


Fig. 1.4. Venous drainage and cutaneous innervation of the abdominal wall

tal vein may activate this collateral venous circulation, producing distension of the paraumbilical veins.

1.5.2 Thoracoepigastric Vein

The thoracoepigastric vein drains the middle portion of the anterolateral abdomen and connects the superficial epigastric and superficial circumflex iliac veins to the lateral thoracic vein. The lateral thoracic vein joins the axillary, which continues with the subclavian and brachiocephalic veins and eventually drains with the great saphenous vein; this, in turn, joins the femoral vein, which continues with the external iliac and common veins and later with the inferior vena cava. Through these elaborate venous connections, the lateral thoracic vein forms a venous link for cava-caval anastomosis. Occlusion of the inferior vena cava is most likely to activate this collateral venous circulation, producing dilation of the thoracoepigastric, the lateral thoracic, and the tributaries of the superficial circumflex iliac and the superficial epigastric veins.

1.5.3 Paraumbilical Veins

The paraumbilical veins are relatively small veins that drain the periumbilical region and into the portal vein.

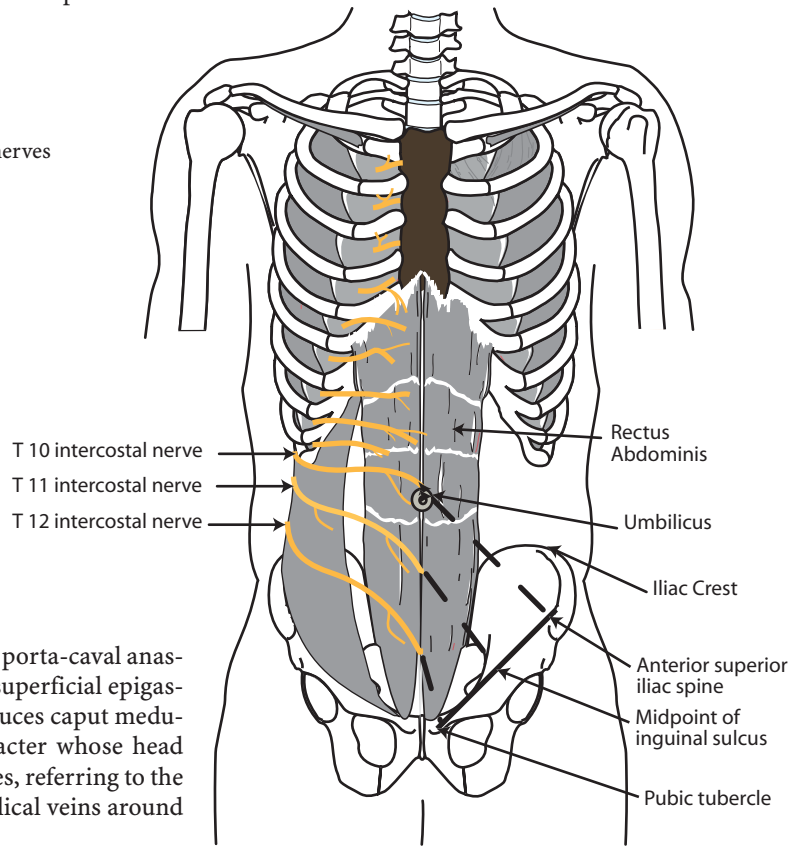


Fig. 1.5. Course of the thoracoabdominal nerves

They are involved in formation of the porta-caval anastomosis via their connections to the superficial epigastric vein. Dilation of these veins produces caput medusa, after a Greek mythological character whose head was covered with a multitude of snakes, referring to the radial pattern of varicosed paraumbilical veins around the umbilicus.

1.5.4 Superficial Circumflex Iliac Vein

The superficial circumflex iliac vein drains the superficial structures in the lower anterior abdominal wall and the proximal region of the superficial thigh. It is connected to the lateral thoracic vein that drains into the superior vena cava via the thoracoepigastric vein. This venous connection may also show dilation in caval obstruction.

1.6 Innervation of the Abdominal Wall

The skin of the anterior abdominal wall is innervated by the ventral rami of the lower five or six thoracic (thoracoabdominal) spinal nerves that continue from the intercostal spaces into the abdominal wall (Fig. 1.5). The anterolateral abdomen also receives nerve fibers from the subcostal, iliohypogastric, and ilioinguinal nerves.

A typical intercostal nerve runs across the deep surface of the internal intercostal muscle and membrane between the internal and innermost intercostal muscles. It then continues in the costal groove below the in-

tercostal artery. Each intercostal nerve is connected to an adjacent sympathetic ganglion by a white communicating ramus conveying presynaptic sympathetic fibers, and by a gray communicating ramus that transmits postsynaptic sympathetic fibers.

1.6.1 Thoracoabdominal Nerves

The seventh and eight intercostal nerves, as is the case with the rest of the intercostal nerves, divide into lateral and anterior cutaneous branches. The lateral branch further divides into anterior and posterior branches, piercing the flat abdominal muscles in the midaxillary line to reach the skin. The anterior cutaneous branches, which represent the terminal branches of the ventral rami of the intercostal nerves, pierce the rectus sheath laterally and emerge anteriorly to reach the skin. They pursue a curved course toward the lateral border of the rectus abdominis, and perforate the transverse abdominis to reach the internal abdominal oblique aponeurosis. After piercing the internal abdominal oblique, they run parallel to the costal margin, enter the posterior surface of the rectus abdominis to continue in its sheath to reach and supply the skin.

The ninth to eleventh intercostal nerves pierce the diaphragm and transverse the abdominis and enter the gap between the transverse and internal oblique, where they pierce the posterior layer of the internal abdominal oblique aponeurosis near its lateral border. Beyond this point, they travel in a similar manner to the seventh and eight intercostal nerves. The ninth intercostal nerve is much larger and should be preserved in a subcostal (Kocher's) incision, which is usually done one inch below the costal arch in individuals with a wider infrasternal angle. The downward and forward direction of the anterior branches of the intercostal nerves brings the tenth intercostal nerve to the umbilicus. The lower intercostal nerves may be entrapped as they pierce the rectus sheath and cause rectus abdominis syndrome, which is characterized by numbness and paresthesia in the median and paramedian areas of the abdomen.

The subcostal nerve, the ventral ramus of the 12th thoracic spinal nerve, is much larger than the intercostal nerves and runs inferior to the corresponding rib with corresponding vessels. It passes posterior to the lateral arcuate ligament and kidney, and anterior to the quadratus lumborum. It pierces the aponeurosis of the transverse abdominis and internal abdominal oblique and then assumes a course similar to that of the lower intercostal nerves. After crossing the iliac crest immediately posterior to the anterior superior iliac spine, the subcostal nerve supplies the pyramidalis via the medial branch and the anterior gluteal skin via its lateral branch.

Since thoracoabdominal nerves also convey sensation from the costal and peripheral diaphragmatic pleura, pleural inflammation can produce pain felt in the abdominal wall. Appendicitis induced pain and rigidity in the abdominal are due to the fact that the sympathetic innervation of the abdominal viscera is derived from the same segments that supply the dermatomes of the anterolateral abdomen. Tuberculosis affecting the lower five thoracic vertebrae can also produce pain that projects to the anterior abdominal wall. Similarly, shingles of the lower ganglia of the thoracic spinal nerves produce diffuse pain and vesicular eruptions in the anterolateral abdominal wall. Referred abdominal pain may also occur as a result of subluxation of the interchondral joints that entraps the intercostal nerves. Constrictive pain, felt as a tight cord around the abdomen, is usually a manifestation of a lesion that has affected a single pair of intercostal nerves. Clicking rib syndrome, which results from subluxation of the interchondral joints of the lower ribs, may cause compression of the lower intercostal nerves and produce pain in the anterior abdomen.

Thoracoabdominal nerves that supply the abdominal muscles form an extensive communicating network that allows considerable overlap. This type of overlap is responsible for the limited or complete lack of perceptible clinical deficits upon damage to one or two nerves. In contrast, the segmental innervation of the rectus abdominis has no or very little cross-linkage. Consequently, individual nerve damage associated with the rectus abdominis is likely to produce deficits in the affected area.

Tapping the anterior abdominal wall produces contraction of the abdominal muscles and thereby reveals the conditions of certain spinal segments. A quick tap at the midclavicular line below the costal arch assesses the integrity of the seventh through the ninth spinal segments. Tapping the area immediately lateral to the umbilicus appraises the condition of the ninth to the eleventh spinal segments. Imparting a quick tap immediately above the inguinal ligament at the midclavicular line discloses information about the eleventh through the first lumbar spinal cord segments [13].

1.6.2 Iliohypogastric Nerve

The iliohypogastric nerve courses posterior to the psoas major and exits through its lateral border posterior to the kidney and anterior to the quadratus lumborum and the iliacus muscles. Near the iliac crest, it pierces and provides innervation to the transverse abdominis and internal abdominal oblique muscles, and splits into lateral and anterior branches. The lateral branch distributes cutaneous branches to the gluteal region, while the anterior branch pierces the internal and external oblique

above the superficial inguinal ring to supply the suprapubic region. When McBurney's incision is employed in appendectomy, superior and medial to the anterior superior iliac spine, the iliohypogastric nerve is preserved and usually isolated from the adjacent structures.

1.6.3 Ilioinguinal Nerve

The ilioinguinal nerve follows a course identical to that of the iliohypogastric nerve. It runs downward and forward between the transverse abdominis and internal oblique. It enters the inguinal canal by piercing the internal oblique to lie between it and the overlying external abdominal oblique aponeurosis. Within the inguinal canal, the ilioinguinal nerve descends inferior and lateral to the spermatic cord in the male, or the round ligament of the uterus in the female. As it emerges via the superficial inguinal ring, it provides sensory fibers to the anterior part of the external genitalia, and motor fibers to the lower part of the internal abdominal oblique and transverse abdominis. The ilioinguinal nerve may be absent or very small, and may join the iliohypogastric nerve.

In a study conducted by Rab et al. [14] on cadaveric specimens, the ilioinguinal nerve provided no sensory branches in 40 % of examined specimens. In 30 % of specimens it shared a branch with the genitofemoral nerve and was the principal nerve to the groin. In the remaining specimens it assumed a primary sensory function supplying the mons pubis, anterior part of the labia majora, inguinal crease, and root of the penis and anterior scrotum.

The ilioinguinal nerve may be damaged in lower quadrant surgical procedures, e.g., appendectomy, resulting in a weakness of the affected abdominal muscles, and predisposition to herniation. Similarly, the course of the ilioinguinal nerve and its genital branches varies considerably, rendering them prone to injury in the repair of an inguinal hernia. A direct inguinal hernia may also develop as a result of damage to the ilioinguinal nerve and subsequent wearing down of the abdominal muscles. Entrapment [15] of the ilioinguinal nerve within the inguinal ligament (ilioinguinal syndrome) may produce debilitating chronic pain in the cutaneous area of its distribution.

Postoperative persistent lower abdominal pain in the absence of gastrointestinal and or gynecologic workup should alert the surgeon to the possibility of ilioinguinal or iliohypogastric nerve entrapment. Painful recurrent neuroma [16] within the ventral abdominal wall can be avoided by neuroectomy using a retroperitoneal proximal resection.

1.6.4 Genitofemoral Nerve

The genitofemoral nerve (L1, L2) pierces the psoas major and emerges on the anterior surface of that muscle. It descends posterior to the ureter and gonadal vessels, and usually divides anterior to the lower third of the psoas major into femoral and genital branches. In the male, the genital branch enters the deep inguinal ring, innervates the cremasteric muscle, emerging from the superficial inguinal ring to supply the scrotum. In the female it follows a similar course and distributes sensory fibers to the skin of the major labium. The femoral branch passes posterior to the inguinal ligament to provide sensory fibers to the upper middle part of the femoral triangle. Due to the variability of the course of the genitofemoral nerve in the inguinal region, entrapment of the genital branch of this nerve may be a possible cause of chronic groin pain [17].

1.7 Lymphatics

Lymphatics of the supraumbilical part of the anterolateral abdominal wall drain into the anterior or pectoral group of the axillary lymph nodes. This group of lymph nodes is located along the inferior border of the pectoralis minor adjacent to the lateral thoracic vessels. Lymphatics from the infraumbilical region drain into the lateral and medial subgroups of the superficial inguinal lymph nodes that lie distal to the inguinal ligament.

1.8 Deep Fascia

The deep fascia of the abdominal wall cannot easily be separated from the underlying epimysium and the aponeuroses of the flat abdominal muscles, and it usually continues with the external spermatic fascia. Anterior to the lower end of the linea alba, this fascia is thickened to form the suspensory ligament of the penis or clitoris and continues with their deep fascia of the external genitalia.

1.9 Musculature of the Anterior Abdominal Wall

The anterolateral abdomen consists of the external and internal abdominal oblique, transverse and rectus abdominis, pyramidalis, as well as the cremasteric muscles. Positive Carnett's sign, which refers to increased tenderness associated with contraction of the abdomi-

nal muscles, usually indicates that the cause of the pain is in the anterolateral abdominal wall and not due to intestinal dysfunction.

The muscles of the anterolateral abdomen maintain intra-abdominal pressure and the position of the viscera, by exerting compressive and twisting force. They facilitate certain physiologic functions such as parturition, vomiting, defecation, urination and coughing. Contraction of these muscles also promotes expiration by depressing and compressing the lower thorax.

1.9.1 External Abdominal Oblique

The external abdominal oblique muscle (Figs. 1.6, 1.7) is the most superficial abdominal muscle that originates from the external surfaces of the lower seven or eight ribs and interdigitates with the serratus anterior and latissimus dorsi muscles. Most of the muscle fibers run downward and medially, forming an aponeurosis near the lateral border of the rectus abdominis. The muscle fibers from the lower two ribs descend vertically downward to attach to the iliac crest. Muscle fibers are rarely found inferior to the line that connects the umbilicus to the anterior superior iliac spine. The vessels and nerves that supply the abdominal wall are contained in the double fascial layer that covers the internal surface of the external abdominal oblique and the external surface of the internal abdominal oblique muscle.

The portion of the muscle that inserts into the outer margin of the iliac crest has a free posterior border, which forms the anterior wall of the inferior lumbar trigone of Petit. This trigone is bounded anteriorly by the external abdominal oblique muscle, posteriorly by the latissimus dorsi, and inferiorly by the iliac crest. It is a weak zone in the abdominal wall can that tends to herniate (Petit's hernia), and the hernial sac is usually broad and less likely to incarcerate.

Three different groups of arteries were identified in a study conducted by Schlenz et al. [18] as the sources of blood supply to the external abdominal oblique. The cranial part of this muscle is supplied by the intercostal arteries. In 94.7 % the deep circumflex iliac artery and in 5.3 % the iliolumbar artery is responsible for the blood supply to the caudal of the muscle. The lateral branches of these arteries run on the outer surface of the muscle, while the anterior branches enter the muscle from its inner surface. Arterial injection studies conducted by Kuzbari et al. [19] have also confirmed the significant contribution of the deep circumflex iliac artery to the blood supply of the external abdominal oblique muscle.

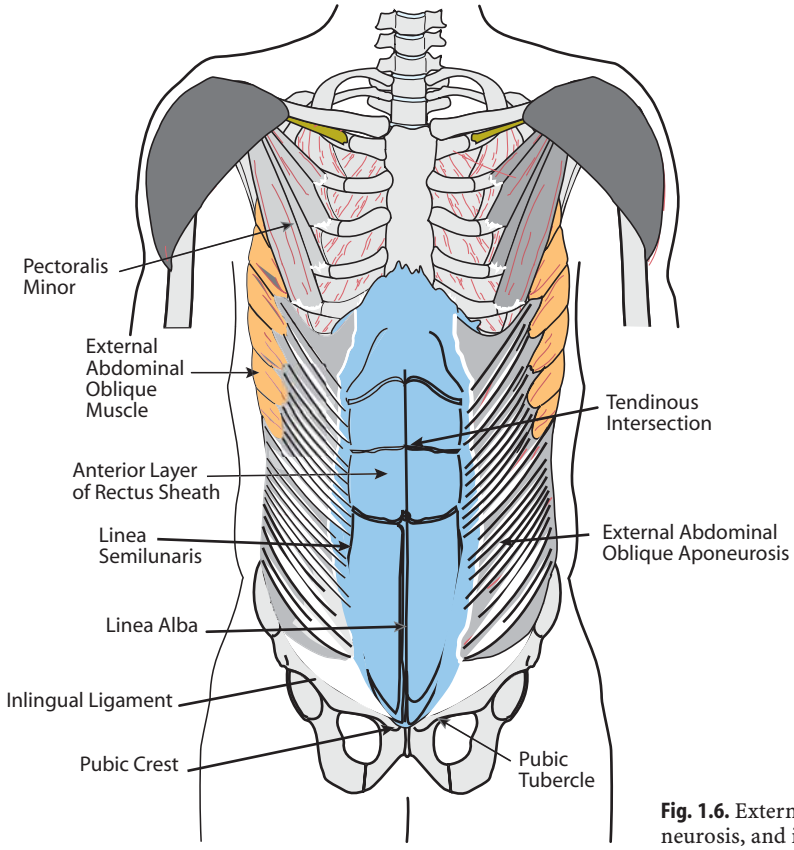


Fig. 1.6. External abdominal oblique muscle and aponeurosis, and inguinal ligament

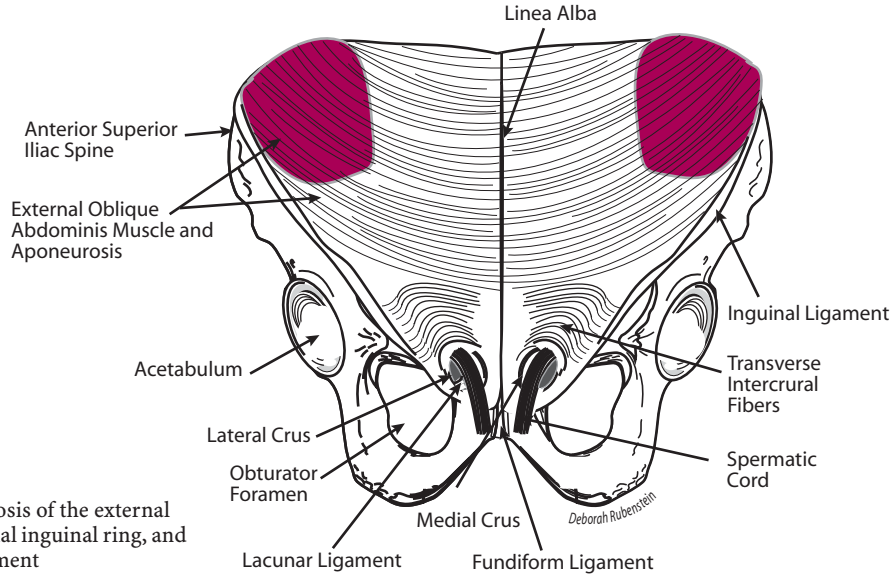


Fig. 1.7. Aponeurosis of the external oblique, superficial inguinal ring, and the inguinal ligament

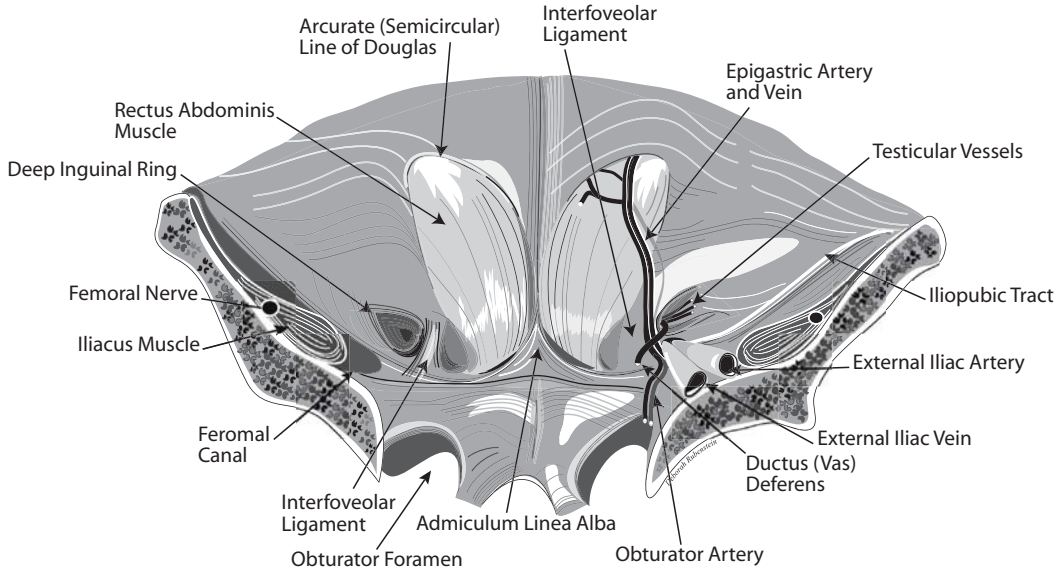


Fig. 1.8. Deep inguinal ring, epigastric vessels, and the structures that pass posterior to the inguinal ligament

The aponeurosis of the external abdominal oblique (Fig. 1.7) runs anterior to the rectus abdominis and joins the aponeurosis of the internal and transverse abdominis at the linea alba. The linea alba is a tendinous midline raphe that extends between from the xiphoid process to the symphysis pubis and pubic crest. It is wider above the umbilicus, separating the recti completely. However, this demarcation may not be easily felt inferior to the umbilicus. As a fibrous structure, it is virtually a bloodless line along which a surgical incision can be made. The triangular part of the linea alba that attaches to the pubic crest is known as the adminiculum linea alba (Fig. 1.8).

Inferiorly, the external oblique aponeurosis attaches to the pubic tubercle, pubic symphysis and crest. The aponeurosis infolds backward and slightly upward upon itself between the anterior superior iliac spine and the pubic tubercle to form the inguinal (Poupart) ligament (Figs. 1.6, 1.7). This ligament, which measures approximately 15 cm, marks the transition between the abdominal wall and thigh. Its curved surface constitutes the floor of the inguinal canal, and maintains an oblique angle to the horizontal.

The reflected part of the inguinal ligament is represented by the fibers of the external oblique aponeurosis that course superiorly and medially to join the rectus

sheath and linea alba (Figs. 1.9, 1.10). This ligament extends from the lateral crus of the superficial inguinal ring toward the linea alba anterior to the conjoint tendon.

A medially and horizontally aligned extension of the inguinal ligament, which is best seen from the abdominal side, extends posterolaterally to attach to the medial end of the pecten pubis and is known as the lacunar (Gimberant's) ligament (Figs. 1.7, 1.8). This triangular ligament (pectineal part of the inguinal ligament) measures 2 cm from base to apex, and forms the medial border of the femoral canal, separating it from the femoral vein. A second lacunar ligament, known as the fascial lacunar ligament, can be seen as an extension of the fascia lata that joins the inguinal ligament, pectineal fascia and the periosteum of the pecten pubis, and receives fibers from the transversalis fascia. The fascial lacunar ligament forms a thickening around the femoral sheath. It is approximately 1 cm anterior and inferior to the pecten pubis and 3 cm lateral to the pubic tubercle.

The superficial inguinal ring (Fig. 1.7), the outer opening of the inguinal canal, appears superior to the inguinal ligament and superolateral to the pubic tubercle. Although the superficial inguinal ring does not as a rule stretch beyond the medial third of the inguinal ligament, it shows some variation in size. In the female it is usually much smaller, accommodating the thin round ligament. The base of the superficial inguinal ring is at the pubic crest and its sides are formed by the medial and lateral crura. The thin medial crura interdigitate anterior to the symphysis pubis while the much stronger lateral crus attaches to the pubic tubercle. Intercrural fibers cross the apex of the superficial inguinal ring and resist widening of this gap. As the spermatic cord passes through the superficial inguinal ring, it rests upon the lateral crus and becomes invested by the external spermatic fascia, which is an extension of the external abdominal aponeurosis.

A robust fibrous band, the Cooper's ligament, extends laterally along the sharp edge of the pecten pubis and connects the base of the lacunar ligament to the pecten pubis. It receives fibers from the pectineal fascia and adminiculum albae (lateral extension from the lower end of the linea alba) and is considered as a firm structure to which sutures can be anchored. The findings of Faure et al. [20] and Rousseau et al. [21] emphasized the role of the ligament of Cooper in laparascopic surgery of the inguinal region and female urinary incontinence. They confirmed the fact that this ligament is a thickening of the pectineal fascia rather than the periosteum. In McVay's technique of repair of inguinal hernia [22, 23], the Cooper's ligament is sutured to the transversalis fascia. The close proximity of this ligament to the femoral vessels must always be remembered.

As the inguinal ligament runs from the anterior superior spine toward the pubic tubercle, it leaves a posterior gap occupied by vessels and nerves that supply the thigh (Fig. 1.8). This gap is divided by the iliopectineal arch, a septum continuous with the iliopsoas fascia and inguinal ligament into vascular (lacuna vasorum) and muscular (lacuna musculorum) compartments. The vascular compartment contains the femoral vein and artery, and the femoral ring, whereas the muscular compartment encloses the femoral nerve and iliopsoas muscle.

1.10 Innervation

The external oblique muscle receives innervation from the anterior primary divisions of the lower five or six intercostal nerves.

1.10.1 External Oblique Muscle

1.10.1.1 Action

Contraction of the external abdominal oblique muscle flexes the vertebral column and helps to rotate the thorax and pelvis. It depresses the thorax in expiration, and supports the abdominal viscera. Other abdominal muscles share many of these actions.

1.10.2 Internal Abdominal Oblique Muscle

The internal abdominal oblique (Figs. 1.9, 1.10) muscle is much thinner and lies deep to the external abdominal oblique. It arises from the iliac crest and the lateral two-thirds of the inguinal ligament, as well as from the thoracolumbar fascia. Fibers of this muscle, particularly those from the iliac crest and thoracolumbar fascia, pursue a reverse course perpendicular to that of the external abdominal oblique, extending for the most part upward and medially.

The part of the muscle that originates from the inguinal ligament becomes aponeurotic and arches over the spermatic cord in the male, or the round ligament in the female. It joins the aponeurosis of the transverse abdominis muscle anterior to the rectus abdominis muscle to form the conjoint tendon (falx inguinalis). It attaches to the pubic crest and for a variable distance to the medial part of the pecten pubis. In the Bassini technique of herniorrhaphy [24–26], the conjoint tendon is sutured to the transversalis fascia and the reflected part of the inguinal ligament. The conjoint tendon joins medially the anterior wall of the rectus sheath and unites laterally with the interfoveolar ligament, an inconstant fibrous

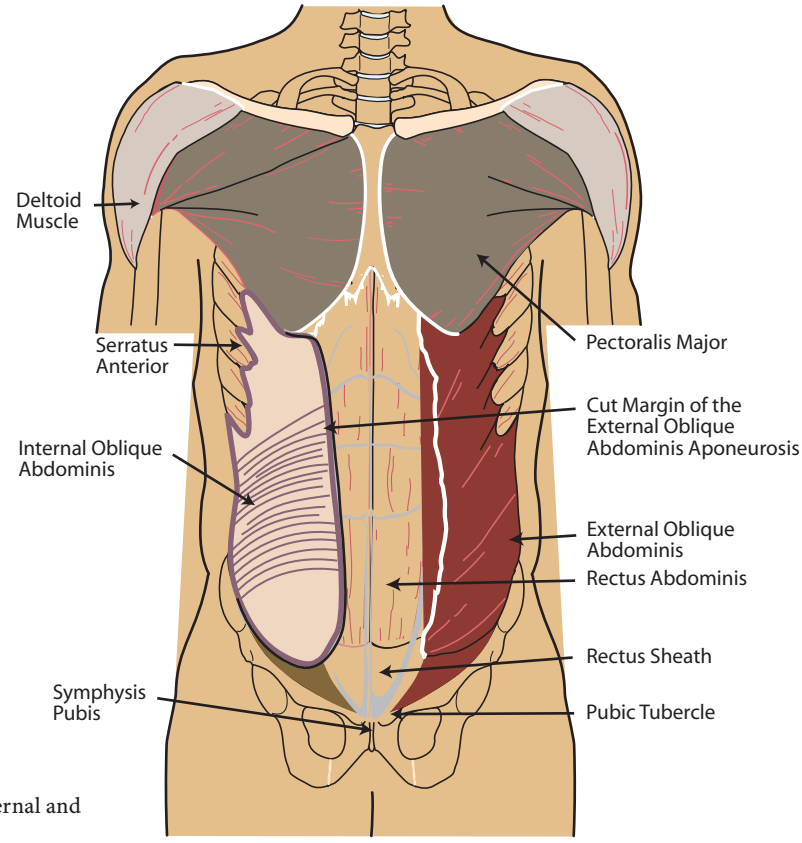


Fig. 1.9. Direction of the fibers of the external and internal abdominal oblique muscle

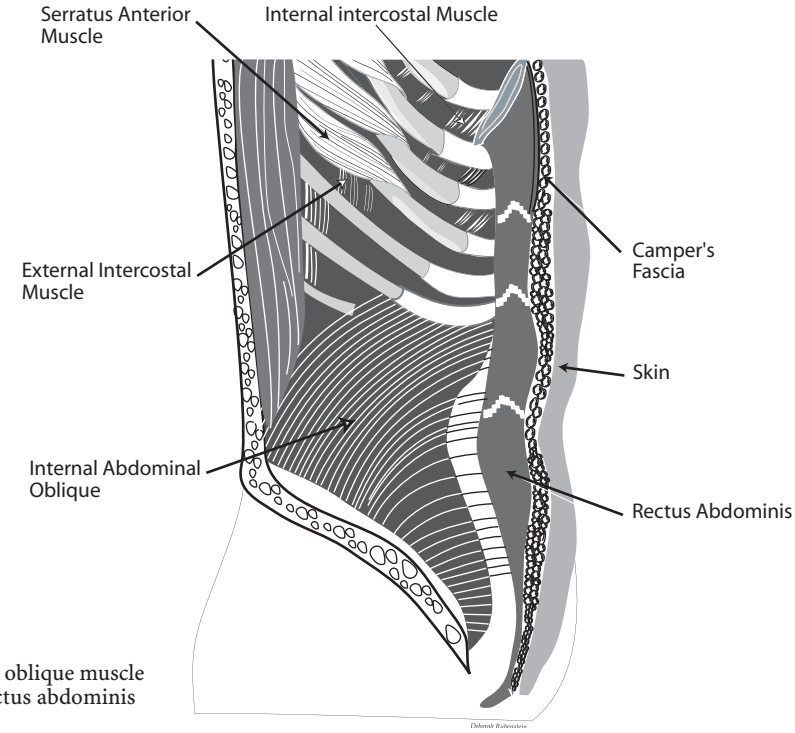


Fig. 1.10. Fibers of the internal abdominal oblique muscle and aponeurosis in relationship to the rectus abdominis muscle

band that connects the transverse abdominis to the superior pubic ramus. However, variations do exist in regard to the extent of attachment of the conjoint tendon and its structural characteristics. The part of the tendon that inserts on the pecten pubis extends posterior to the superficial inguinal ring, forming a natural barrier that prevents the occurrence of inguinal hernia. A direct inguinal hernial pouch may pass through this tendon, acquiring the coverings of this structure.

The posterior fibers of the internal abdominal oblique muscles that gain origin from the iliac crest extend upward and laterally to the inferior border of the lower three or four ribs, continuing with the internal intercostal muscles. They become aponeurotic towards the midline and contribute to the formation of the linea alba by joining the aponeurosis of the flat abdominal muscles of the same and opposite side.

Superior to the midpoint between the umbilicus and the symphysis pubis (upper two-thirds), the internal oblique aponeurosis divides into two layers. The anterior layer covers the anterior surface of the rectus abdominis and the posterior layer invests the posterior surface of the rectus abdominis. Distal to this site (lower one-third), the aponeurosis of the internal oblique remains a single layer anterior to the rectus abdominis (Fig. 1.11).

The loosely arranged fasciculi of the internal oblique muscle and its aponeurosis, which extend around the spermatic cord and testis, constitute the cremasteric muscle and fascia that invariably receive fibers from the transverse abdominis. The cremasteric, a striated muscle with a lateral and a medial part, is an involuntary muscle innervated by the genital branch of the genitofemoral nerve (L1, L2). The lateral part is thicker, directly arises from the inguinal ligament, and extends to the anterior superior iliac spine. The medial part of the internal abdominal oblique, which is sometimes absent, arises from the pubic tubercle, conjoint tendon, and possibly the transverse abdominis.

From the inferior edge of the internal abdominal oblique, the cremasteric muscle and fascia loop over the spermatic cord and testis to terminate at the pubic tubercle and merge with the anterior layer of the rectus sheath. This muscle is considered to have internal and external components separated by the internal spermatic fascia [27]. Redman [28] concluded that exposure of the inguinal canal and deep inguinal ring in hernial repair is greatly enhanced by careful dissection of the cremasteric muscle and fascia.

In the female, the round ligament is invested by the sporadic fibers from the lateral part of the cremasteric muscle. Contraction of the cremasteric muscle mediates the cremasteric reflex, a brisk reflex, particularly in children, which involves elevation of the testicles towards the superficial inguinal ring upon stimulation of the inner thigh.

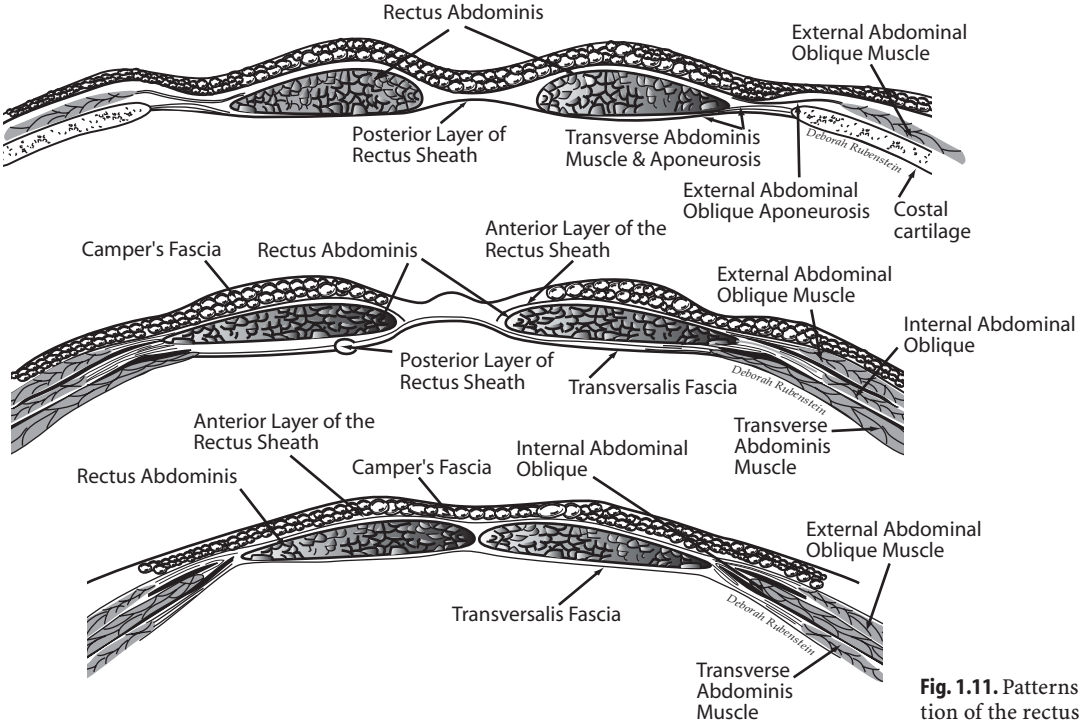


Fig. 1.11. Patterns of lamination of the rectus sheath

1.10.2.1 Action

Bilateral contraction of the external abdominal oblique muscles, in conjunction with the internal oblique and rectus abdominis, produces flexion of the vertebral column. Ipsilateral contraction of the external and internal abdominal oblique muscles produces abduction of the trunk (lateral flexion to the same side). Contraction of the external abdominal oblique on one side and the internal oblique on the opposite side results in rotation of the lumbar vertebral column.

1.10.2.2 Innervation

The internal abdominal oblique is innervated by the ventral rami of the lower six intercostal, iliohypogastric and ilioinguinal nerves.

1.10.3 Transverse Abdominis Muscle

The transverse abdominis (Figs. 1.2, 1.12–1.16) is a wide thin muscular layer that assumes a nearly hori-

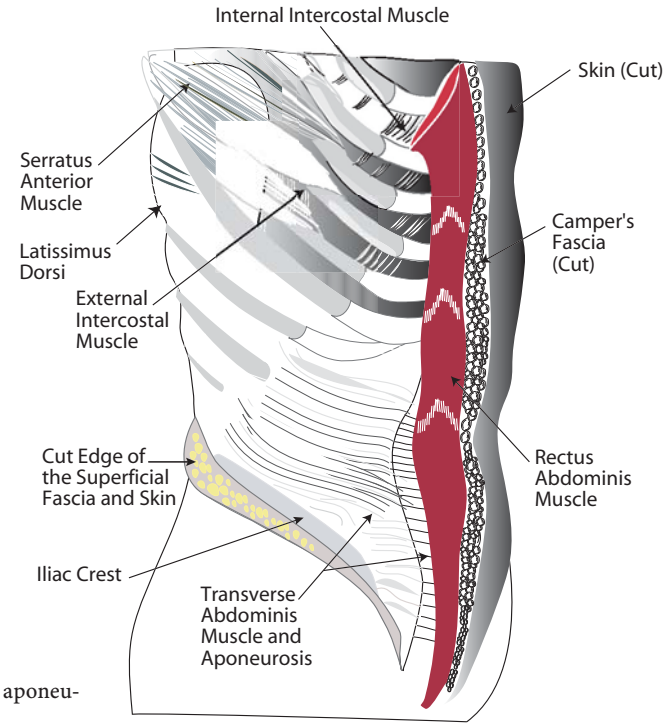


Fig. 1.12. Transverse abdominis muscle and aponeurosis

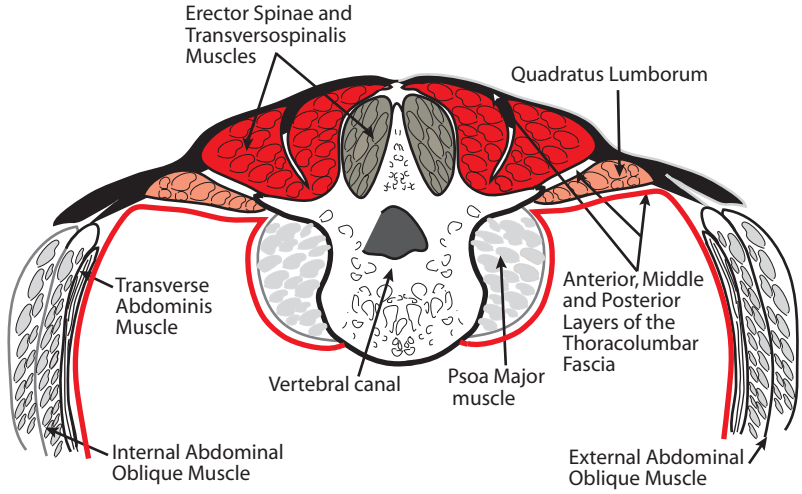


Fig. 1.13. Cross section of the posterolateral abdominal wall showing the external and internal abdominal oblique, transverse abdominis, and the thoracolumbar fascia

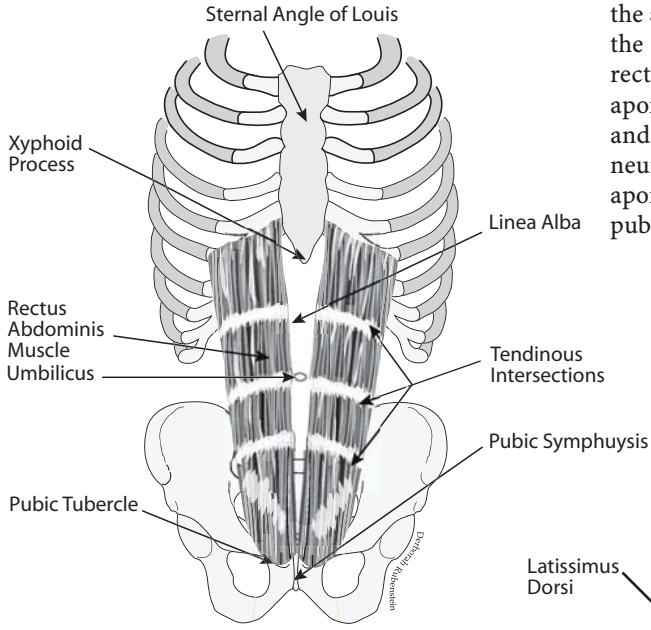
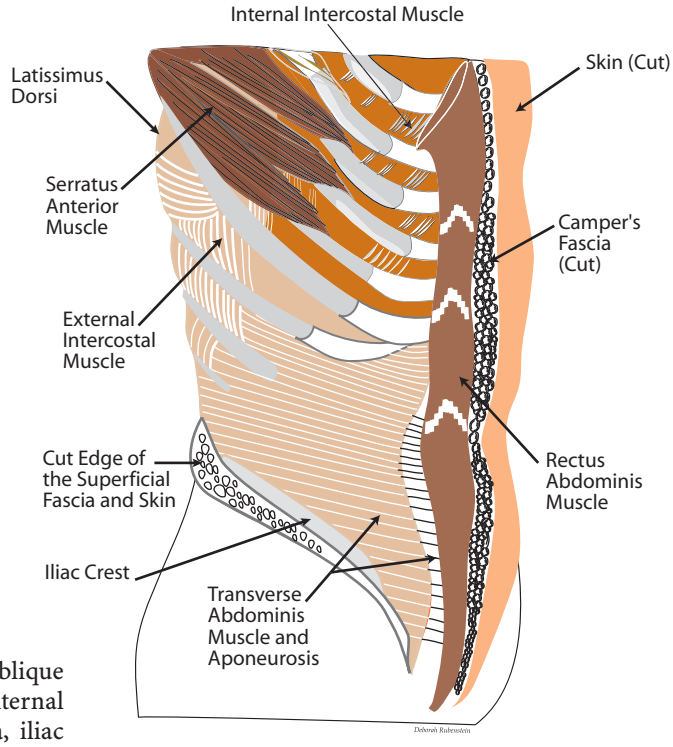


Fig. 1.14. Proximal and distal attachments of the rectus abdominis



▷
Fig. 1.15. Rectus abdominis muscle in relation to the transverse abdominis and superficial fascia of the abdomen

zontal course deep to the internal abdominal oblique muscle. It maintains a similar origin to the internal oblique, arising from the thoracolumbar fascia, iliac crest and the lateral third of the inguinal ligament. The transverse abdominis receives additional origin from the inner surface of the lower five or six ribs, partly interdigitating with the origin of the muscular diaphragm. This muscle may be absent or fused with the internal abdominal oblique and may contain openings filled with fascia. It becomes aponeurotic as it approaches the lateral border of the rectus abdominis, blending with the linea alba. At the level of the xiphoid process, the transverse abdominis becomes aponeurotic near the linea alba, allowing the muscular part to pursue a course deeper to the rectus abdominis.

Superior to the midpoint between the umbilicus and symphysis pubis (upper two-thirds), the aponeurosis of the transverse abdominis joins the anterior layer of the aponeurosis of the internal abdominal oblique and the external oblique to form the anterior layer of the rectus sheath. Inferior to the midpoint, the transverse aponeurosis runs posterior to the rectus abdominis and anterior to the muscle. The lower fibers of the aponeurosis curve downward and medially and join the aponeurosis of the internal abdominal oblique at the pubic crest to form the conjoint tendon.

1.10.3.1 Innervation

This muscle is innervated by the ventral rami of the lower five or six intercostal nerves, as well as by the subcostal, iliohypogastric and ilioinguinal nerves.

1.10.3.2 Action

The effect of contraction of the transverse abdominis on the vertebral column is not clear, despite its role as a compressive force resisting intra-abdominal pressure.

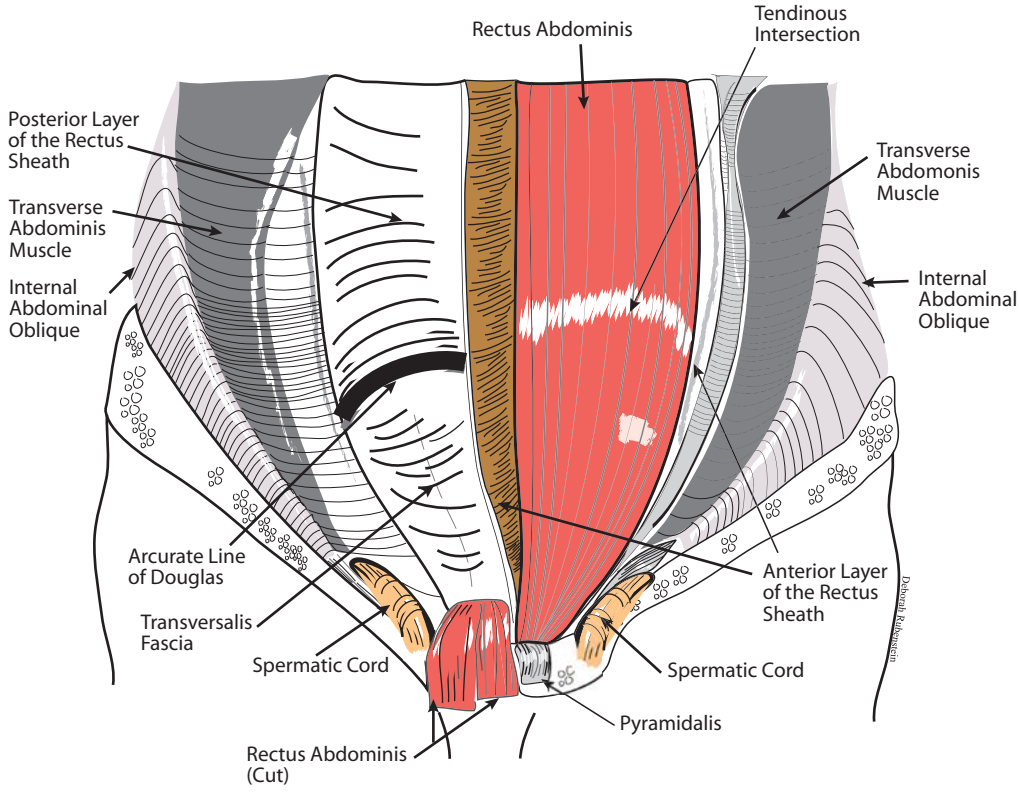


Fig. 1.16. Posterior layer of the rectus sheath, arcuate line of Douglas, internal abdominal oblique, and transverse abdominis

It is believed that the actions of the transverse abdominis are basically common to the internal and external abdominal oblique muscles. The transverse abdominis is believed to respond more to increases in chemical or volume-related drive than the rectus abdominis and external abdominal oblique. This is supported by neuroanatomical studies that have demonstrated many more inputs to, and outputs from, the motor neurons that innervate the transverse abdominis muscle than can be accounted for by its respiratory role [29].

1.10.4 Rectus Abdominis

The rectus abdominis (Figs. 1.5, 1.6, 1.8–1.10, 1.16), a paired longitudinal muscle on both sides of the midline, widens as it descends through the rectus sheath, maintaining distal and proximal attachments. Proximally, it attaches to the xiphoid process and the costal cartilages of the fifth through the seventh ribs. Distally it attaches via a medial tendon to the pubic symphysis, interlacing with the opposite muscle and via a lateral tendon to the pubic crest, extending to the pecten pubis and pubic tubercle. The site of intersection of the lateral border of the right rectus and costal arch marks the topographic location of the fundus of the gallbladder. The recti muscles are completely separated in the midline above the umbilicus by the linea alba and less so below it. Its lateral border forms the semilunar line, a curved groove that extends from the pubic tubercle to the ninth costal cartilage, which is particularly visible in muscular individuals. This muscle is usually interrupted by three transversely running tendinous intersections that assume a zigzag path and firmly adhere to the anterior layer of the rectus sheath. The upper tendinous intersection is usually near the xiphoid process; the lower one is at the level of the umbilicus and is segmentally related to the tenth rib and tenth intercostal nerve; and the middle one is found between the above intersections.

In order to gain access to the rectus abdominis, the rectus sheath should carefully be dissected off the rectus muscle and the associated segmental artery and vein are severed at each of the intersections. A paramedian incision that cuts through the anterior layer of the rectus sheath and rectus abdominis carries the advantage of protecting the sutured peritoneum when the rectus abdominis slips back into its proper anatomical position. Since this muscle receives innervation through its lateral border (Figs. 1.4, 1.5) by piercing the tendinous intersections, incisions immediately lateral to the rectus abdominis near the linea semilunaris can

carry a great risk of denervation and atrophy. Therefore, the rectus abdominis can surgically be transected anywhere other than the sites of these fibrous intersections, without possible threat of herniation. Cosmetic [30] results are greatly enhanced when the approximation of the recti muscles is combined with a flap advancement and rotation of the external abdominal oblique muscle.

The rectus sheath (Figs. 1.8, 1.11, 1.16) consists of the aponeuroses of the external and internal oblique and transverse abdominis muscles, exhibiting two primary patterns of laminations demarcated by the arcuate line of Douglas (Figs. 1.8, 1.16). This line corresponds to the midpoint between the umbilicus and the symphysis pubis. Proximal to the arcuate line the aponeuroses of the external abdominal oblique and the anterior layer of the internal abdominal oblique form the anterior layer of the rectus sheath. At this level, the posterior layer comprises the aponeuroses of the transverse abdominis and the posterior layer of the internal abdominal oblique as well as the transversalis fascia. Distal to the arcuate line, the anterior layer of the rectus sheath is formed by the combined aponeuroses of the external and internal oblique and the transverse abdominis. At this level, the posterior layer is only formed by the transversalis fascia that separates the rectus abdominis from the peritoneum.

Since the aponeuroses of the internal oblique and transverse abdominis only extend to the costal margin, the rectus abdominis above this level rests on the costal cartilages, and the anterior layer of the sheath at this level is formed only by the external oblique aponeurosis. Immediately below the costal margin, the transverse abdominis muscle extends posterior to the rectus muscle. The rectus sheath contains the pyramidalis muscle, the superior and inferior epigastric vessels and the terminal branches of the lower five or six intercostal nerves.

Although spontaneous hematoma into the rectus sheath as a result of a rupture of the epigastric vessels is rare in pregnancy, acute abdominal pain in the third trimester or at the beginning of the postpartum period should alert the surgeon for this very possibility [31, 32]. Diastasis recti, a symptomatic separation of the recti by a stretching or widening of the linea alba, is commonly associated with parturition.

1.10.4.1 Innervation

The rectus abdominis muscle is segmentally innervated by the ventral rami of the lower six or seven thoracic spinal nerves.

1.10.4.2 Actions

With the pelvis fixed, the recti act as flexors of the lumbar vertebral column; with the thorax fixed, they draw the pelvis upward. The recti come to action as flexors,

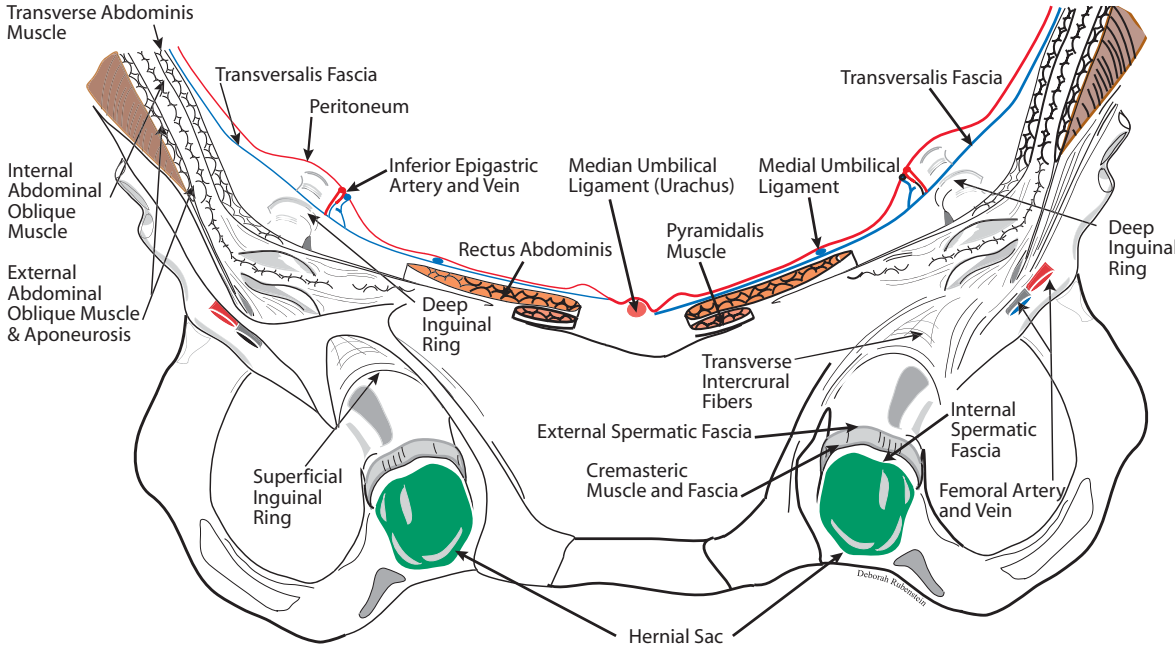


Fig. 1.17. Course of a hernial sac in the indirect inguinal hernia. Observe the inguinal canal, inferior epigastric vessels and the protruding hernial sac

particularly in the supine position, overcoming gravitational pull.

1.10.5 Pyramidalis Muscle

The pyramidalis (Fig. 1.17), an inconstant small muscle which is absent in approximately 25% of the population, originates from the symphysis pubis and pubic crest and inserts into the linea alba as far as one-third of the distance to the umbilicus. This triangular muscle lies anterior to the lower end of the rectus abdominis and becomes smaller and pointed as it ascends towards the junction of the linea alba and the arcuate line. Although the significance of this muscle is not clear, it is thought to tense the linea alba.

1.10.5.1 Innervation

The pyramidalis muscle is innervated by the subcostal nerve and occasionally by branches of the iliohypogastric and ilioinguinal nerves.

1.11 Transversalis Fascia

The transversalis fascia [33, 34] is a segment of the endoabdominal fascia that forms the lining of the entire abdominal cavity. It contributes to the posterior wall of the rectus sheath and contains the deep inguinal ring midway between the anterior superior iliac spine and the symphysis pubis. It lies between the transverse abdominis and the extraperitoneal fat and continues inferiorly with the iliac and pelvic fascia and superiorly with the fascia on the inferior surface of the diaphragm. Although it is a very thin layer on the inferior surface of the diaphragm, it shows some thickening in the inguinal region. In the posterior abdominal wall it joins the anterior layer of the thoracolumbar fascia. The transversalis fascia attaches to the iliac crest and to the posterior margin of the inguinal ligament as well as to the conjoint tendon and the pecten pubis. Its prolongation around the spermatic cord, known as the internal spermatic fascia, fuses with the parietal layer of the tunica vaginalis. It blends with the iliac fascia as it forms the anterior layer of the femoral sheath.

Anterior to the femoral vessels, the transversalis fascia is augmented by the transverse crural arch, a horizontally disposed layer that descends to attach medially to the pecten pubis and laterally to the anterior superior iliac spine. The transverse crural arch plays an important role in strengthening the medial and inferior margins of the deep inguinal ring. Menck and Lierse [35] have demonstrated that the transversalis fascia consists of an internal and an external layer; the internal layer contributes to the sphincteric mechanism that reduces the size and strengthens the deep inguinal ring. The role of the transversalis fascia in inguinal hernial repair and reinforcement of the dorsal wall of the inguinal canal has been suggested by Morone et al. [36] and Witte et al. [37]. The study conducted by Teoh [38] confirmed the presence of the iliopubic tract as a thickening of the transversalis fascia that runs parallel to the inguinal ligament and believed to be a significant structure in various approaches to repair of inguinal hernia. It attaches to the superomedial part of the pubic bone medially, but laterally it joins the iliac fascia with no bony attachments.

1.12 Extraperitoneal Fatty Tissue

The extraperitoneal tissue (subserous fascia) is a generally thin connective tissue layer that occupies the area between the peritoneum and the transversalis fascia in the abdomen, and between the peritoneum and the endopelvic fascia in the pelvis. It is loose and fatty in the lowest portion, allowing for the expansion of the bladder. The potential space represented by this loose preperitoneal layer, the space of Bogros, is used for the placement of prostheses in the repair of inguinal hernia. This layer is particularly thick and fatty in the posterior abdomen as it surrounds the major vessels and also the kidney to form the perinephric renal capsule. The extraperitoneal tissue also shows thickening around the iliac crest and pubic bone.

1.13 Peritoneum

The peritoneum is part of the coelomic cavity that becomes separated from the pleural cavities by the development of the diaphragm. The free surface of this extensive membrane is covered by a layer of mesothelium, saturated by a thin film of serous fluid. The peritoneum is a serous membrane that resembles, but is much more complicated than, the pleura essentially due to the fact that in the course of fetal development rotations of the gut allow certain parts of the abdominal viscera to variably invaginate into the peritoneum. However, this process does not occur in the thoracic cavity and the pleura maintains a much simpler arrangement. In general the peritoneum consists of parietal and visceral layers separated by the peritoneal cavity. The parietal layer forms the lining of the abdominal walls and the diaphragm separated from the transversalis fascia by an extraperitoneal connective tissue. Although loosely attached to the abdominal wall, it is

denser and firmly adherent to the linea alba and inferior surface of the diaphragm. It converts the umbilical ligaments into folds. The median umbilical fold covers the urachus, an embryological remnant of the allantois, which is connected to the apex of the urinary bladder. The medial umbilical fold, located lateral to the median umbilical fold, is formed by the (upper) obliterated part of the umbilical artery. The lower (non-obliterated) part of the umbilical artery remains functional in the adult. The lateral umbilical (epigastric) fold is located lateral to the medial umbilical fold, covering the inferior epigastric vessels.

Since the lower five intercostal nerves and branches of the first lumbar spinal segment innervate the skin, muscles and also the parietal peritoneum, peritonitis may stimulate these nerves, thereby producing pain, involuntary spasmodic contraction of all abdominal muscles, and palpable rigidity (guarding). These important manifestations signify inflammation of the parietal peritoneum.

In contrast, the visceral peritoneum invests the abdominal viscera to various degrees. An organ which is completely invested by the visceral peritoneum is considered an intraperitoneal organ. Intraperitoneal organs include the spleen, stomach, initial part of the duodenum, tail of the pancreas, jejunum, ileum, transverse colon, and sigmoid colon. Conversely, a retroperitoneal organ is covered by the peritoneum anteriorly and laterally or only anteriorly. Retroperitoneal organs include the kidney, ureter, suprarenal gland, inferior vena cava, abdominal aorta, ascending and descending colon, most of the duodenum, and the rectum.

The visceral peritoneum is innervated by sympathetic and parasympathetic fibers. Since sympathetic fibers are the principal carriers of visceral pain, inflammation of the visceral peritoneum produces referred pain in the dermatomes that correspond to the segmental sympathetic innervation of the affected organs.

1.14 Inguinal Canal

The inguinal canal [39] is an oblique tunnel that borders the anterior thigh and extends from the superficial to the deep inguinal ring, running parallel to and above the inguinal ligament. It develops between the 5th and the 32nd week of prenatal life, initially as the processus

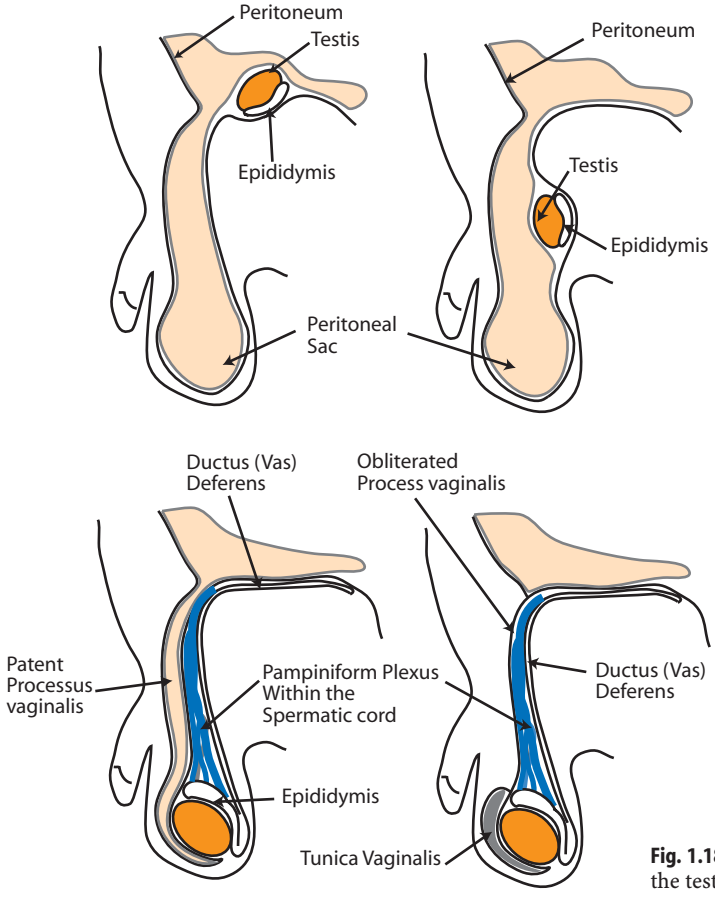


Fig. 1.18. Formation of the process vaginalis, descent of the testis, and the spermatic cord

vaginalis, a peritoneal evagination that extends into the transversalis fascia. The processus vaginalis (Fig. 1.18) eventually loses its connection with the peritoneal cavity of the abdomen and persists as a double-walled serous layer, the tunica vaginalis, anterior and lateral to the testis. The transversalis fascia continues with the internal spermatic fascia in the form of a tubular sheath that travels forward, first by passing between the arched fibers of the aponeuroses of the transverse abdominis and internal abdominal oblique abdominis, and finally through the external abdominal oblique aponeurosis (Fig. 1.19). During the passage of the processus vaginalis and internal spermatic fascia through the aponeuroses of the internal and external abdominal oblique, they acquire additional coverings from the cremasteric muscle and fascia, and the external spermatic fascia.

The triangular gap proximal and lateral to the pubic crest that marks the continuation of the external spermatic fascia with the external abdominal oblique aponeurosis is known as the superficial inguinal ring. This opening, formed by a division of the fibers of the external abdominal oblique aponeurosis, is bounded by medial and lateral crura. The medial crus passes superomedially to join with the corresponding fibers of the contralateral side. The fibers of the lateral crus extend inferolateral to the superficial inguinal ring, forming the medial end of the inguinal ligament. Variable fibrous strands that run across the upper part of the superficial inguinal ring form the intercrural fibers. These fibers play a role in strengthening the superficial inguinal ring and preventing further splitting of the fibers of the external oblique aponeurosis.

The deep inguinal ring is a funnel-shaped opening in the transversalis fascia; it is located lateral and superior to the inferior epigastric vessels, and inferior to the arched lower margin of the aponeurosis of the transverse abdominis. Although size variations do exist, the deep inguinal ring is almost always larger in the male to accommodate the spermatic cord and its components. It is approximately 2.54 cm above the midpoint of the inguinal ligament, corresponding to the site of passage of the femoral artery under the inguinal ligament. The precise location of the deep inguinal ring as 0.52 cm lateral to the midinguinal point and 0.46 cm medial to the midpoint of the inguinal ligament has been documented by Andrews et al. [40]. Neither the midinguinal point nor the midpoint of the inguinal ligament can accurately predict the position of the deep inguinal ring.

The force exerted by the contraction of the internal abdominal oblique muscle on the margins of the deep inguinal ring may play an important role in preventing herniation. The oblique direction of the inguinal canal, the strength of the abdominal muscles, and the traction exerted by the internal oblique abdominis muscle during strenuous activity appear to compensate for weakness of the anterior abdominal wall. Presence of the conjoint tendon and the reflected inguinal ligament directly posterior to the superficial inguinal ring also play an important role in counteracting the weakness in the inguinal area. Contraction of the abdominal muscles forces the wall of the inguinal canal to collapse and thus act as a safety valve, preventing the occurrence of hernia in normal individuals.

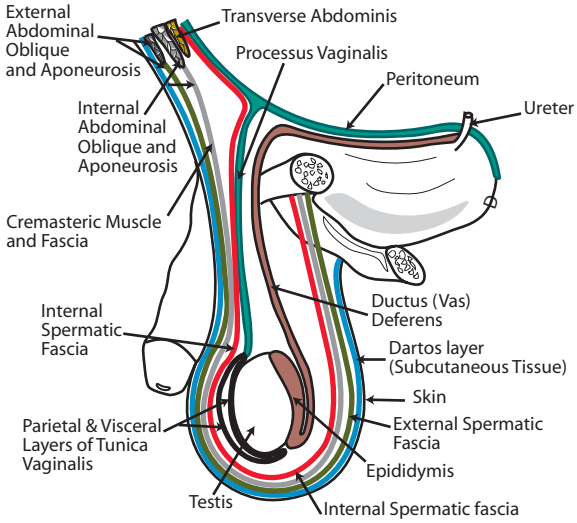


Fig. 1.19. Coverings of the testis and spermatic cord

The inguinal canal is bounded superiorly (on its roof) by the arched lower free fibers of the internal abdominal oblique and the transverse abdominis muscles and inferiorly (on its floor) by a combination of the inguinal and lacunar ligaments and the transversalis fascia. It is enclosed anteriorly by the aponeurosis of the external and abdominal internal oblique muscles and posteriorly by the transversalis fascia, falx inguinalis, and the reflected inguinal ligament. This canal contains the spermatic cord and ilioinguinal nerve in the male, and the round ligament of the uterus and ilioinguinal nerve in the female.

In the male (Fig. 1.18), descent of the gonads from the posterior abdominal wall follows the gubernaculum hunteri [41], a mesenchymal tissue that extends from the posterior abdominal wall to the deep inguinal ring. The processus vaginalis, guided by the gubernaculum, protrudes through the deep inguinal ring and descends to the scrotum, as additional fascial coverings are added to it. Variations in the attachments of the gubernaculum to the testis may determine the location of the testis. A recent study [42] found the proximal portion of the gubernaculum to be attached to the testes and epididymis in all fetuses that did not exhibit congenital malformations or epididymal alterations, such as tail disjunction or elongated epididymis. In undescended (cryptorchid) testes, an increased incidence of

gubernacular attachment anomalies was accompanied by paratesticular structural malformations compared to the testes of normal fetuses. Cryptorchid testes are frequently located in the inguinal canal, sometimes in the femoral canal and suprapubic region (at the base of the penis), and rarely found in the contralateral scrotum or perineal region [43]. Tanyel et al. [44] reported neurogenic changes within all cremasteric muscles of boys with cryptorchid testis.

In the female, the gonads follow a much shorter course, and the gubernaculum attaches to the ovary and the uterus during its descent toward the anterolateral abdomen. The portion of the gubernaculum that connects the ovary to the uterus becomes the proper ovarian ligament. The remaining part, which extends through the anterolateral abdomen, develops into the round ligament of the uterus that travels through the inguinal canal to the major labium. Since the round ligament attaches to the anterolateral abdomen before the inguinal canal is completely formed, it does not have the same fascial coverings as the processus vaginalis in the male. In the female, the coverings are so thin that they are indistinguishable from the round ligament itself.

In the male, obliteration of the processus vaginalis, and thus the connection between the peritoneal cavity in the abdomen and scrotum, is usually complete at birth. However, this process may begin late, and when it does, it becomes completed by the first few weeks of postnatal life. Closure begins at the deep inguinal ring and extends downward to involve all the intervening regions.

The only postnatal remnant of the processus vaginalis is a closed sac anterior and lateral to the testis, known as the tunica vaginalis. Failure of the processus vaginalis to close (patent processus vaginalis) may allow part of the abdominal viscera to protrude through the deep inguinal ring and follow the course of the inguinal canal to the superficial inguinal ring, producing an indirect inguinal hernia. Kahn et al. [45] published a report that objectively confirms that presence of a patent processus vaginalis is not a prerequisite to the development of indirect inguinal hernia.

The tunica vaginalis (Fig. 1.18) consists of visceral and parietal layers separated by a cavity that contains a thin film of fluid. Accumulation of fluid in this cavity produces hydrocele, a condition that exhibits transilluminating scrotal swelling anterior to the testis. Hydrocele can be a primary (idiopathic) or secondary condition. A primary hydrocele is usually large and rigid, occurs over the age of 40, and develops slowly. A secondary hydrocele tends to occur in younger individuals as a sequel to inflammation or tumors of the testis. A congenital hydrocele associated with indirect inguinal hernia is usually large and full during the day and shrinks during the night. A spermatic cord hydrocele tends to move downward when traction is applied to the testis.

The blood supply, venous and lymphatic drainage, and innervation of the testis are associated with the posterior abdominal wall and are contained within the spermatic cord (Figs. 1.7, 1.18, 1.19). This cord is a composite bundle that contains the vas deferens (ductus deferens), testicular artery, pampiniform venous plexus, deferential artery, and the genital branch of the genitofemoral nerve. It is covered by the external spermatic fascia, cremasteric muscle and fascia and the internal spermatic fascia. Separation of the vas deferens and associated vessels within the spermatic cord from the processus vaginalis and attainment of inguinal orchiplexy can successfully be accomplished by division of the internal spermatic fascia [46].

The vas deferens (Figs. 1.18, 1.19), a cord-like structure rich in smooth muscle fibers, begins as a direct continuation of the tail of the epididymis and ascends in the center of the spermatic cord, entering the abdominal wall via the superficial inguinal ring. Subsequent to its course through the deep inguinal ring into the pelvis, it joins the duct of the seminal vesicle to form the ejaculatory duct. Bilateral congenital absence of the vas deferens is associated with azoospermia and may determine the likelihood of cystic fibrosis [47].

The testicular artery (Fig. 1.19) emanates from the abdominal aorta and descends anterior to the ureter, coursing within the inguinal canal to supply the testis. The angle between the ductus deferens and the testicular vessels, and the thickness of the adjacent tissue around the deep inguinal ring, show great variations. This angle, which constitutes the apex of what is called the "triangle of doom", may be used as a point of reference to predict the position of the ductus deferens, thereby preventing accidental surgical stapling of the underlying external iliac vessels during herniorraphy [48]. The thickness of the peritoneum, transversalis fascia, and intervening connective tissue is greatest lateral to the testicular vessels and least over the ductus deferens.

The deferential artery, a branch of the inferior vesical artery, forms an extensive anastomosis with the testicular and the cremasteric arteries. The cremasteric artery arises from the inferior epigastric artery and supplies the cremasteric muscle and fascia. The pampiniform plexus (Fig. 1.18) travels through the inguinal canal and gives rise to a number of veins that coalesce to form the right and left testicular veins, which drain into the inferior vena cava and the left renal vein, respectively. Dilation of the pampiniform plexus produces varicocele, a condition that is usually visible when standing or straining. It is associated with defective valves in the plexus, thrombosis of the left renal vein, renal diseases, and rarely with superior mesenteric artery syndrome.

The round ligament of the uterus, a remnant of the gubernaculum, follows the inguinal canal from the

deep to the superficial inguinal ring and eventually reaches the major labium. It is considerably stretched during pregnancy and maintains the anteverted position of the uterus. The wall of this ligament contains great numbers of smooth muscle fibers near the uterus; these diminish toward the deep inguinal ring, converting into fibrous strands as it reaches the major labium. The round ligament courses diagonally within the mesometrium toward the pelvic floor anterior to the external iliac, obturator, and vesical vessels, and the obliterated umbilical artery. The round ligament allows some lymphatics from the cervix and fundus of the uterus to follow its course to the superficial inguinal lymph nodes.

1.15 Abdominal Hernias

A hernia, meaning "sprouting forth", is an outpouching of a visceral organ or a part of organ through an opening that it does not normally transverse. When hernias are associated with the abdomen, they may occur through the inguinal canal, lumbar trigone of Petit, femoral canal, or umbilicus. Nerve damage and weakening of the muscles, as a postsurgical complication, may lead to herniation. A variety of other situations such as pregnancy, constipation, peritoneal dialysis, ascites, and asthma may predispose an individual to herniation. Each hernia consists of a sac, usually a diverticulum of the parietal peritoneum that invests the hernial contents, and a protruded tissue or organ with its coverings. The proximal tapered end of the sac that marks the site of herniation is known as the neck of the hernial sac. Although the ratio of the length of the inguinal canal to the circumference of the hernial sac may define the clinical picture best, this parameter cannot be the sole determinant of the clinical outcome. Abdominal wall hernias are usually asymptomatic, discovered incidentally on routine physical examination. However, complications of abdominal hernia may be life threatening and require urgent medical attention.

1.15.1 Inguinal Hernia

The bony attachments of the inguinal region counteract abdominal thrust, and the presence of natural gaps that exist in this region may allow peritoneal diverticula to externalize and appear as hernias. Inguinal hernia sac, which represents approximately 95 % of abdominal wall hernias in the male and 50 % in the female, has the highest incidence of onset in the 1st year of life followed by a second peak between the ages of 16 and 20. Hernial sac traverses the entire length of the inguinal canal from the deep to the superficial inguinal ring. It may also pursue a much shorter path, passing only through the superficial inguinal ring. The hernial sac appears above and medial to the pubic tubercle. Herniation that follows the entire length of the inguinal canal is an indirect inguinal hernia; it commonly results from persistent processus vaginalis and therefore is known as an indirect (congenital) inguinal hernia. The Hessert's triangle, formed by the intersection of the aponeurosis of the internal oblique and transverse aponeuroses and the rectus sheath, may play an important role in the etiology of the inguinal hernia [49]. This triangle may be occluded upon contraction of the abdominal muscles and by their movement toward the inguinal ligament. However, when a larger triangle exists, the occlusion cannot be complete, a condition that leads to herniation.

Inguinal hernia is often asymptomatic, but some patients, particularly the middle-aged and elderly, experience aching pain in the lower abdominal quadrants that radiates to the medial thigh. Others relate the sudden occurrence of the condition to strenuous activity. Patients may report an intermittent, reducible or nonreducible groin mass. In infants, it is thought that thickening of the spermatic cord at the superficial inguinal ring on one side is an important sign of an inguinal hernia. The infrequent occurrence of inguinal hernia in the female is commonly attributed to the small size of the superficial inguinal ring and the fatty composition of the major labium.

Laparoscopic procedures in the repair of inguinal hernia have produced an increase in the frequency of debilitating neuropathies, most notably those of the genitofemoral, ilioinguinal, and lateral femoral cutaneous nerves. The highly variable course of the lateral femoral cutaneous nerve and its branches within the pelvis may directly account for this complication [50]. Aszman [51] demonstrated five different types of relationships of the lateral femoral cutaneous nerve to soft tissue and bony structures. Four percent (type A) maintained a course posterior to the anterior superior iliac spine and across the iliac crest; 27 % (type B) traveled anterior to the anterior superior iliac spine, within the inguinal ligament and superficial to the origin of the sartorius muscle. In 23 % (type C) the nerve ran medial to the anterior superior iliac spine within the tendinous origin of the sartorius, and in 26 % (type D) the nerve was found deep to the inguinal ligament between the iliopsoas fascia and the sartorius muscle. In the same study 20 % (type E) pursued a course deep to the inguinal ligament within the soft tissue anterior to the iliopsoas muscle, joining the femoral branch of the genitofemoral nerve. This study has suggested that the lateral femoral cutaneous nerve is most prone to damage when it pursues a course indicated by types A, B, or C.

In a study conducted by Rosenberg et al. [52], the course of the genitofemoral, lateral femoral, and ilioin-

guinal nerves and their relationships to the deep inguinal ring, iliopubic tract, and anterior superior iliac spine were carefully examined. The findings indicate that both branches of the genitofemoral nerve penetrate the abdominal wall lateral to the deep inguinal ring and cranial to the iliopubic tract. The ilioinguinal and lateral femoral cutaneous nerves pursued a course immediately lateral to the anterior superior iliac spine. It concluded that placement of staples either cranial to the iliopubic tract or lateral to the anterior superior iliac spine is likely to produce injury to these nerves.

Hospodar et al. [53] examined, in a series of cadaveric pelvis, the lateral femoral cutaneous nerve with respect to the ilioinguinal surgical dissection. In approximately 10% of the pelves examined the lateral femoral cutaneous nerve was found either within a half-centimeter of the iliopubic tract or in the vertical plane of the anterior superior iliac spine. These are the principal anchoring sites for mesh in laparascopic hernial repair. In another study, the lateral femoral cutaneous nerve was most commonly found at 10–15 mm from the anterior superior iliac spine (ASIS), and as far medially as 46 mm. Because of this variation, careful dissection medial to the ASIS may be essential to locate the nerve.

1.15.2 Indirect Inguinal Hernia

Indirect inguinal hernia (Fig. 1.19) occurs when the processus vaginalis persists, connecting the peritoneal cavity of the abdomen and that of the scrotum or major labium. Indirect inguinal hernia is common in all ages and in both sexes. Kahn and Hamlin [45] concluded that patent processus vaginalis is not always a prerequisite for the occurrence of indirect inguinal hernia. It is often associated with cryptorchid testis and hydrocele. Incarcerated indirect inguinal hernia may occur as a complication of spilled gallstones [54–56]. Persistent processus vaginalis may be unmasked by the presence of fluid that fills this peritoneal extension and presents as a scrotal or occasionally as labial edema. In a large indirect inguinal hernia, the inguinal canal is no longer oblique due to the close proximity of the dilated superficial and deep inguinal rings. Since the deep inguinal ring lies lateral to the inferior epigastric vessels, the neck of the hernial sac protrudes through the lateral inguinal fossa, shifting these vessels medially. As it traverses the deep inguinal ring, the hernial sac is invested by the internal spermatic fascia. After pushing up the arching fibers of the transverse and internal abdominal oblique, it becomes invested by the cremasteric muscle and fascia. It emerges at the superficial inguinal ring and descends to the scrotum, where it is covered by the external spermatic fascia, superficial fascia, and the skin. The hernial sac may be strangulated and the blood supply compromised at the deep inguinal ring. Surgical relief may require a superolateral cut to avoid any possible injury to the inferior epigastric vessels.

It may appear in infancy or early adult life subsequent to forced opening of a preexisting or partially patent processus vaginalis during a strenuous activity, such as lifting of heavy objects, or repeated stresses on the wall during sneezing, coughing or vomiting. Pediatric inguinal hernia is almost always indirect and bilateral with right side predominance, and is prone to incarceration and strangulation.

In the male, the hernial sac descends into the scrotum anterior to the spermatic cord testis, and is usually felt as an impulse at the examiner's fingertip upon a sudden increase in intra-abdominal pressure. In the female, the hernial sac descends through a much narrower canal to the major labium; as a result, palpation of the hernial sac is not adequate. This is particularly evident with women in whom the expanding impulse on coughing is not easily felt due to the overlying fatty tissue.

1.15.3 Direct Inguinal Hernia

Direct inguinal hernia is a form of acquired outpouching in which the hernial sac runs through the posterior wall of the inguinal canal and protrudes through the superficial inguinal ring without entering the deep inguinal ring. The neck of the hernial sac is medial to the inferior epigastric vessels and within the supravesical fossa or the Hesselbach's (inguinal) triangle. The supravesical fossa [57–59] lies superior to the urinary bladder between the medial and median umbilical ligaments. Since the conjoint tendon is anterior to the supravesical fossa and posterior to the superficial inguinal ring, the hernial sac either passes between the fibers of the conjoint tendon or is completely covered by this tendon. When the hernial sac pierces the conjoint tendon it will be covered by the peritoneum as well as by the aponeurosis of the internal abdominal oblique and transverse abdominis muscle.

Hesselbach's triangle is bounded medially by the rectus abdominis, laterally by the inferior epigastric vessels, and inferiorly by the inguinal ligament [60]. When the hernial sac passes through Hesselbach's triangle, it is usually lateral to the conjoint tendon and will be invested by the extraperitoneal fat, transversalis fascia, external spermatic fascia, superficial fascia, and the skin. In individuals with direct inguinal hernia, the spermatic cord is usually posterolateral to the hernial sac, not posterior to it as in indirect hernia. When the hernial sac is occasionally large, it may protrude into the scrotum or major labium.

Direct inguinal hernia is a commonly bilateral condition that occurs as a result of weakness of the transversalis fascia. Since the path of the hernial sac does not involve the muscular layers or tendinous borders and

the neck of the hernial sac is wide, the risk of incarceration is low. On standing, the hernial sac is felt as a diffuse medial outpouching over the inguinal canal, which is not controlled by digital pressure applied immediately proximal to the femoral artery. Direct inguinal hernia is a less common type of hernia, is age related, usually affects men over age 40, and is rare in women. It is an acquired condition associated with obesity, constipation, and benign prostatic hypertrophy. It is usually asymptomatic and is even less noticeable than the indirect type. This type of hernia is not contained in the spermatic cord, and unless the hernial sac is large it rarely extends to the scrotum or major labium. The hernial sac protrudes anteriorly and pushes the side of the examiner's index finger forward. Both direct and indirect inguinal hernia may protrude on each side of the inferior epigastric vessels as pantaloon hernia.

1.15.4 Femoral Hernia

A femoral hernia presents a hernial sac that protrudes anterior to the pectineal (Cooper's) ligament and through the femoral canal, a potential space between the lacunar ligament and the femoral vein. The femoral ring, which is the upper margin of the femoral canal, is the medial portion of the lacuna vasorum. It is bounded anteriorly by the extension of the transversalis fascia, and posteriorly by the continuation of the pectineal fascia. The neck of the hernial sac is always distal and lateral to the pubic tubercle, a bony landmark between the site of inguinal and femoral hernia. The fundus of the hernial sac (lower part) usually occupies the medial part of the femoral triangle.

The hernial sac traverses the femoral canal and descends vertically posterior to the inguinal ligament, displacing the femoral vein, to exit through the saphenous opening. It tends to ascend from this point proximally, by following the superficial epigastric vessels anterior to the inguinal ligament and the lower part of the external oblique. The hernial sac may turn medially and toward the scrotum or major labium. It may also descend anterior (prevascular hernia) or posterior (retrovascular hernia) to the femoral vessels. It is prevented from descending further down by the attachment of the femoral sheath and the superficial fascia of the thigh to the margins of the saphenous opening. The course of progression of the hernial sac should be taken into consideration and reduction of femoral hernia should be directed in the reverse direction with the thighs passively flexed.

Femoral hernia is more common in female than male at the ratio of 3 : 1. It affects approximately 35 % of the female population particularly in women over 50 years of age. This gender-based difference is attributed to the unique shape of the pelvis, the size of the ring, and the dramatic changes exerted during pregnancy. Its incidence is far lower than that of inguinal hernia and can be easily missed during physical examination.

There is a dramatic correlation between inguinal hernial repair and the incidence of femoral hernia. Mikkelsen et al. [61] reported a 15-fold greater incidence of femoral hernia postinguinal herniorrhaphy compared with spontaneous incidence. Due to the rarity of the femoral hernia in children and the similarity of its manifestations to that of the indirect inguinal hernia, femoral hernia in this population remains a challenging clinical problem.

Misdiagnosis of femoral hernia may be perpetuated by the presence of a patent processus vaginalis and incidental indirect inguinal hernia [62, 63]. A variety of conditions must be excluded in the differential diagnosis of femoral hernia such as lipoma, psoas abscess, obturator hernia, lipoma, and hydrocele.

The femoral hernial sac consists of the parietal peritoneum, femoral septum (extraperitoneal tissue), femoral sheath, cribriform fascia (covers the saphenous opening), superficial fascia, and skin. It frequently contains the small intestine and omentum, but the presence of an inflamed appendix, Meckel's diverticulum, or portion of the bladder should also be expected. Occasionally the ureter or broad ligament of the uterus may also be found. Femoral hernial sac becomes irreducible when it attains a large size, protruding anterior to the inguinal ligament. Due to the ligamentous boundaries, the hernial sac carries a higher risk of strangulation and should be considered part of the differential diagnosis in pregnant women and in individuals with intestinal obstruction. The strangulation is a frequent manifestation at the saphenous opening, the femoral ring, or at the junction of the inguinal ligament and falciform margin of the saphenous opening [64].

1.15.5 Umbilical Hernia

Umbilical hernia, common among African-American children, is associated with failure of complete closure of the umbilical orifice during the 1st year of postnatal life [2]. It is often noticed when the infant cries, which raises the intra-abdominal pressure and causes protrusion of part of the intestine. Surgery becomes essential when the defect is relatively large and persists beyond the age of 4, or becomes incarcerated. In the adult, umbilical hernia may develop more commonly in women, usually postpartum, and a pose serious danger due to the rigid walls of the linea alba, which predisposes the hernial sac to strangulation and incarceration.

Herniation immediately above or below the umbilicus is known as paraumbilical hernia, and occurs in women with multiple pregnancies. It is usually prone to incarceration and usually contains part of the greater omentum.

1.15.6 Omphalocele

Omphalocele is a rare but severe congenital umbilical hernia in which part of a visceral organ protrudes through the umbilical ring into the base of the umbilical cord. This condition begins when the cranial limb of the gut loop coils and rapidly increases in length, protruding through the umbilical ring into the extraembryonic coelomic cavity [2]. This physiological herniation occurs around the 6th week of development, followed by the return of the protruding part of the gut into the enlarged abdominal cavity around the 10th week. Retention of the herniated gut outside the abdomen beyond the 10th week of development is designated as omphalocele. The hernial sac in this case is covered by the combination of a thin layer of peritoneum and by the amnion. In a study involving a large number of consecutive births [3], the overall survival rate was much lower for omphalocele than for gastroschisis. The same study confirmed that omphalocele is usually associated with older maternal age pregnancies, and is more often complicated by threatened abortion.

1.15.7 Epigastric Hernia

Epigastric hernia refers to a protrusion of the peritoneal fat, usually without peritoneal sac, through the linea alba of the epigastrium. The hernial sac may be in the form of a reducible midline nodule that becomes evident in the standing position. It usually contains extraperitoneal fat or it may contain part of the greater omentum or small intestine. Epigastric hernia may produce severe pain, due to ischemia that mimics chronic peptic ulcer.

1.15.8 Incisional Hernia

Incisional hernia occurs up to 5 years following surgical procedures at a site of previous laparatomy where healing was not complete. Postlaparascopy incisional hernia is generally a minor complication and rarely strangulates [65]. It can be visualized by having the patient perform the Valsalva maneuver or raise his or her head while in the supine position. It is the most common type of hernia among all ventral abdominal hernias, and is associated with old age, obesity, improper suturing techniques, postoperational strain, cirrhosis, steroid therapy, infection, hematoma, and ileus. Due to the relatively large size of the neck of the hernial sac, strangulation is rare.

1.15.9 Lumbar Hernias

Lumbar herniation may occur through the superior or inferior lumbar spaces. It is classified as congenital and acquired; the acquired lumbar hernia is subdivided into primary and secondary types. The hernial sac usually consists of the peritoneum, or extraperitoneal tissue, and may contain part of the intestine, kidney, omentum, or mesentery. The hernia produces mild symptoms and can easily be surgically reduced and very rarely becomes strangulated. The superior lumbar hernia occurs through Gynfelt's triangle [66], which is bounded superiorly by the 12th rib and the serratus posterior inferior muscle, laterally by the internal oblique, and medially by the erector spinae muscle. Inferior lumbar hernia [67] is very rare and occurs through Petit's triangle, bounded anterolaterally by the external abdominal oblique, inferiorly by the iliac crest, and posteromedially by the latissimus dorsi muscle.

1.15.10 Spigelian Hernia

The Spigelian hernia is a defect in the aponeurosis of the transverse abdominis muscle between the semilunar line and the lateral border of the rectus abdominis (Spigelian aponeurosis). The semilunar (Spigelian) line represents the transition of the transverse abdominis from muscle to aponeurosis. The hernial sac and the opening cannot usually be palpated because of the intramural location of the hernial sac posterior to the aponeurosis of the external oblique aponeurosis [68]. It can present synchronously with inguinal hernias in neonates, and regardless of age of presentation is almost always congenital in origin [69].

1.15.11 Richter's Hernia

Richter's hernia, which was first described in 1598, refers to the hernial protrusion that contains only a portion of the intestinal wall at any site in the anterolateral abdomen. The involved segment incarcerates or strangulates and may undergo gangrene, but symptoms of ischemic bowel or complete intestinal obstruction are often absent. The hernial sac most commonly occurs at the femoral and inguinal rings and is associated with a high mortality rate [70]. Richter's femoral hernia exhibits vague abdominal signs, groin swelling, but with no intestinal obstruction [71].

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Anesthesia for Liposuction and Abdominoplasty 2

Gary Dean Bennett

2.1 Introduction

Since the development of the first outpatient surgical program in 1966 and the first freestanding surgical centers in 1969, the number of surgeries performed outside of the hospital setting has dramatically increased. An estimated 70 % of all elective surgery is performed in an outpatient setting [1], and more than 50 % of aesthetic plastic surgeons perform most of their procedures in an office setting [2].

The popularity of surgeries performed outside of the hospital setting is a consequence of multiple factors. Clearly, economic considerations play a major role in the shift to ambulatory surgery. Because of greater efficiency, these outpatient surgical units have greater cost-effectiveness [3]. Advances in monitoring capabilities and the adoption of monitoring standards of the American Society of Anesthesiologists (ASA) are credited for a reduction of perioperative morbidity and mortality [4]. Advances in pharmacology have resulted in a greater diversity of anesthetic agents with rapid onset, shorter duration of action and reduced morbidity [5]. The advent of minimally invasive procedures has further reduced the need for hospital-based surgeries. Regulatory agencies such as the American Association of Accreditation of Ambulatory Surgery (AAAASF) and the Accreditation Association for Ambulatory Health Care (AAAHC) have helped establish minimum standards of care for surgical locations where anesthesia is administered. Ambulatory anesthesia has even become a formal subspecialty of anesthesia with the establishment of the Society of Ambulatory Anesthesia (SAMBA) in 1984. An evaluation of 1.1 million outpatients revealed that the mortality rate after ambulatory anesthesia was 1.5 per 100,000 cases [6]. No deaths occurred in 319,000 patients who were monitored in accordance with ASA standards [7, 8].

As a consequence of the shift away from hospital-based surgery, the surgeon has adopted a more important role in the medical decision making process with respect to anesthesia. Frequently, the surgeon decides on the location of surgery, the extent of the preoperative evaluation, the type of anesthesia to be administered, the personnel to be involved in the care and monitoring of the patient, the postoperative pain management, and the discharge criteria used. Therefore, it is incumbent on the surgeon to understand current standards of anesthesia practice. If the surgeon chooses to assume the role of the anesthesiologist, then he or she must adhere to the same standards that are applied to the anesthesiologist. While the morbidity and mortality of anesthesia has decreased [9, 10], risk awareness of anesthesia and surgery must not be relaxed.

2.1.1 The Surgical Facility

The surgeon is largely responsible for deciding in which facility the procedure is to be performed. Surgical facilities may be divided into five main categories:

1. Hospital-based inpatient
2. Hospital-associated ambulatory surgical unit
3. Freestanding surgical center with short-stay accommodation
4. Freestanding surgical centers without short-stay accommodation
5. Office based operating rooms.

Each of these choices has distinct advantages and disadvantages. While convenient and economical, office based surgery is associated with three times the mortality of surgeries performed at other types of facilities [11]. Ultimately, patient safety should be the paramount factor in the final decision. Patients with a risk of ASA III undergoing major liposuction or large abdominoplasty should preferentially be treated at hospital-based or hospital-associated surgical units rather than office-based operating rooms [12 – 14].

If the intended surgical procedure requires general anesthesia or enough sedative-analgesic medication to increase the probability of loss of the patient's life preserving protective reflexes (LPPRs), then, according to the law in some states, the surgical facility must be accredited by one of the regulatory agencies (AAAASF or AAAHC) [15, 16].

Regardless of which type of facility is selected or the type of anesthesia planned, the operating room must

be equipped with the type of monitors required to fulfill the monitoring standards established by the ASA [17], as well as proper resuscitative equipment and resuscitative medications [18, 19]. The facility must be staffed by individuals with the training and expertise required to assist in the care of the patient [19, 20]. Emergency protocols must be established and rehearsed [21]. Optimally, the surgical facility must have ready access to a laboratory in the event a stat laboratory analysis is required. Finally, a transfer agreement with a hospital must be established in the event that an unplanned admission is required [18, 19].

2.1.2 Personnel

One of the most critical elements of successful surgical outcomes is the personnel assisting the surgeon. Qualified and experienced assistants may serve as valuable resources potentially reducing morbidity and improving efficiency of the operating room [22, 23]. With an office-based operating room the surgeon is responsible for selecting the operating room personnel.

An anesthesiologist or a Certified Nurse Anesthetist (CRNA) may administer anesthesia. The surgeon may prefer to perform the surgery using exclusively local anesthesia without parenteral sedation, especially in limited liposuctions with the tumescent technique [24]. However, many surgeons add parenteral sedative or analgesic medications with the local anesthetic. If the surgeon chooses to administer parenteral sedative-analgesic medications, then another designated, licensed, preferably experienced individual should monitor the patient throughout the perioperative period [25]. Use of unlicensed, untrained personnel to administer parenteral sedative analgesic medication and monitor patients may increase the risk to the patient. It is also not acceptable for the nurse monitoring the patient to double as a circulating nurse [26]. Evidence suggests that anesthesia related deaths more than double if the surgeon also administers the anesthesia [27]. Regardless of who delivers the anesthesia, the surgeon should preferably maintain current Advanced Cardiac Life Support certification (ACLS) and all personnel assisting in the operating room and recovery areas must maintain Basic Life Support Certification [28]. At least one ACLS certified health provider must remain in the facility until the patient has been discharged [29].

2.1.3 Preoperative Evaluation

The time and energy devoted to the preoperative preparation of the surgical patient should be commensurate with the efforts expended on the evaluation and preparation for anesthesia. The temptation to leave preoperative anesthesia preparation of the patient as an afterthought must be resisted. Even if an anesthesiologist or CRNA is to be involved later, the surgeon bears responsibility for the initial evaluation and preparation of the patient. Thorough preoperative evaluation and preparation by the surgeon increases the patient's confidence, reduces costly and inconvenient last minute delays, and reduces overall perioperative risk to the patient [30]. If possible, the preoperative evaluation should be performed with the assistance of a spouse, parent or significant other so that elements of the health history or recent symptoms may be more readily recalled.

A comprehensive preoperative evaluation form is a useful tool with which to begin the initial assessment. Information contained in the history alone may determine the diagnosis of the medical condition in nearly 90 % of patients [31]. While a variety of forms are available in the literature, a checklist format to facilitate the patient's recall is probably the most effective [32]. Regardless of which format is selected, information regarding all prior medical conditions, prior surgeries and types of anesthetics, current and prior medications, adverse outcomes to previous anesthetics or other medications, eating disorders, prior use of antiobesity medication, and use of dietary supplements, which could contain ephedra, should be disclosed by the patient.

A family history of unexpected or early health conditions such as heart disease, or unexpected reactions, such as malignant hyperthermia, to anesthetics or other medications should not be overlooked. Finally, a complete review of systems is vital to identifying undiagnosed, untreated, or unstable medical conditions that could increase the risk of surgery or anesthesia. Last minute revelations of previously undisclosed symptoms, such as chest pain, should be avoided.

Indiscriminately ordered or routinely obtained preoperative laboratory testing is now considered to have limited value in the perioperative prediction of morbidity and mortality [33 – 37]. In fact, one study showed no difference in morbidity in healthy patients without preoperative screening tests versus a control group with the standard preoperative tests [38]. Multiple investigations have confirmed that the preoperative history and physical examination is superior to laboratory

Table 2.1. Guidelines for preoperative testing in healthy patients (ASA 1 – 11). (Adapted from Roizen et al. [305])

Age	Test
12 – 40[a]	CBC
40 – 60	CBC, EKG
Greater than 60	CBC, BUN, glucose, ECG, CXR

[a] Pregnancy test for potentially childbearing females is suggested

Table 2.2. Common indications for additional risk specific testing. (Adapted from Roizen et al. [306])

	Electrocardiogram	Chest X-ray	Electrolytes, glucose, liver function tests, BUN, creatinine	Urinalysis
History	Coronary artery disease, congestive heart failure, prior myocardial infarction, hypertension, hyperthyroidism, hypothyroidism, obesity, compulsive eating disorders, deep venous thrombosis, pulmonary embolism, smoking, chemotherapeutic agents, chemical dependency, chronic liver disease	Bronchial asthma, congestive heart failure, chronic obstructive pulmonary disease, pulmonary embolism	Diabetes mellitus, chronic renal failure, chronic liver disease, adrenal insufficiency, hypothyroidism, hyperthyroidism, diuretic use, compulsive eating disorders, diarrhea	Diabetes mellitus, chronic renal disease, and recent urinary tract infection
Symptoms	Chest pain, shortness of breath, dizziness	Chest pain, shortness of breath, wheezing, unexplained weight loss, hemoptysis	Dizziness, generalized fatigue or weakness	Dysuria, urgency, frequency, and bloody urination
Signs	Abnormal heart rate or rhythm, hypertension, cyanosis, peripheral edema, wheezing, rales, rhonchi	Cyanosis, wheezes, rales, rhonchi, decreased breath sounds, peripheral edema, abnormal heart rate or rhythm	Abnormal heart rate or rhythm, peripheral edema, jaundice	

analysis in determining the clinical course of surgery and anesthesia [39–43]. Newer guidelines for the judicious use of laboratory screening are now widely accepted. Table 2.1 outlines a general approach for healthy patients not taking medications. Additional preoperative tests may be indicated for patients with prior medical conditions or risk factors for anesthesia and surgery (Table 2.2).

Consultation from other medical specialists should be obtained for patients with complicated or unstable medical conditions. Patients with ASA III risk designation should be referred to the appropriate medical specialist prior to elective surgery [25]. The consultant's role is to determine if the patient has received optimal treatment and if the medical condition is stable. Additional preoperative testing may be considered necessary by the consultant. The medical consultant should also assist with stabilization of the medical condition in the perioperative period if indicated. If the surgeon has concerns about a patient's ability to tolerate anesthesia, a telephone discussion with an anesthesiologist or even a formal preoperative anesthesia consultation may be indicated.

Certain risk factors, such as previously undiagnosed hypertension, cardiac arrhythmias, and bronchial asthma may be identified by a careful physical examination. Preliminary assessment of head and neck anatomy to predict possible challenges in the event endotracheal intubation is required may serve as an early warning to the anesthesiologist or CRNA even if a general anesthetic is not planned. For most ambulatory surgeries, the anesthesiologist or CRNA evaluates the patient on the morning of surgery.

2.1.4 Preoperative Risk Assessment

The ultimate goals of establishing a patient's level of risk are to reduce the probability of perioperative morbidity and mortality. The preoperative evaluation is the crucial component of determining the patient's preoperative risk level. There is compelling evidence to suggest that the more coexisting medical conditions a patient has, the greater the risk for perioperative morbidity and mortality [25, 44]. Identification of preoperative medical conditions helps reduce perioperative mortality.

A variety of indexing systems have been proposed to help stratify patients according to risk factors. One such classification, first proposed in 1941 [45], later modified in 1961 by Dripps [46], and finally adopted by the ASA in 1984 (Table 2.3) [47], has emerged as the most widely accepted method of preoperative risk assessment. Numerous studies have confirmed the value of the ASA system in predicting which patients are at a higher risk for morbidity [48] and mortality [49–51]. Goldman and Caldera established a multifactorial index based on cardiac risk factors [52]. This index has repeatedly demonstrated its usefulness in predicting perioperative mortality [53, 54]. Physicians should incorporate one of the acceptable risk classification systems as an integral part of the preoperative evaluation.

Multiple authors have documented the association between morbidity and mortality and the type of surgery [55–58]. The consensus of these studies confirms the increased risks of perioperative complications for more invasive surgeries, surgeries with multiple combined procedures, surgeries with prolonged duration, and surgeries with significant blood loss [59]. While

Table 2.3. The American Society of Anesthesiologists' Physical Status Classification

ASA Class I	A healthy patient without systemic medical or psychiatric illness
ASA Class II	A patient with mild, treated and stable systemic medical or psychiatric illness
ASA Class III	A patient with severe systemic disease that is not considered incapacitating
ASA Class IV	A patient with severe systemic, incapacitating and life threatening disease not necessarily correctable by medication or surgery
ASA Class V	A patient considered moribund and not expected to live more than 24 h

studies correlating the amount of fat aspirate during liposuction or the amount of tissue removed during abdominoplasty with perioperative morbidity and mortality have not been performed, it would not be unreasonable to extrapolate conclusions from the previous studies and apply them to abdominoplasty and liposuction. Liposuction surgeries with less than 1,500 ml fat aspirate are generally considered less invasive procedures, while liposuctions aspirating more than 3,000 ml are considered major surgical procedures [19]. As blood loss exceeds 500 cc [59], or the duration of surgery exceeds 2 h, morbidity and mortality increase [48, 60].

2.2 Anesthesia in Patients with Preexisting Disease

Over the past 30 years the morbidity and mortality of surgery have steadily declined [10]. One hypothesis to explain this decline has been the greater recognition of preoperative risk factors and the improved perioperative medical management of patients with coexisting diseases. Surgeons who perform outpatient surgery, especially office-based surgery, and particularly those surgeons who choose to administer sedative or analgesic medication, must appreciate how these medical conditions may increase the risk of anesthesia in the surgical patient. Furthermore, the surgeon should maintain a current, working understanding of the evaluation and treatment of these medical conditions.

2.2.1 Cardiac Disease

Cardiac related complications, including myocardial infarction and congestive heart failure, are the leading cause of perioperative mortality [62, 63]. Most patients with heart disease can be identified with a careful preoperative history and physical [64]. Since 80 % of all episodes of myocardial ischemia are silent [65, 66], a high index of suspicion for silent ischemia must be maintained when assessing asymptomatic patients with risk factors for heart disease, such as smoking, hypertension, diabetes mellitus, obesity, hyperlipidemia, or family history of severe heart disease. Patients with known cardiac disease must be evaluated by the internist or cardiologist to ensure the medical condition is optimally managed. When anesthesia is planned, patients with significant heart disease should preferentially undergo surgery at a hospital-based surgical unit rather than a physician's office.

Most studies have consistently demonstrated that patients who have suffered previous myocardial infarctions have a dramatically greater risk of reinfarction and death if surgery is performed less than 6 months after the cardiac event [67 – 69]. More recent studies suggesting a lower rate of reinfarction [70, 71] involved patients who were hospitalized in the intensive care unit with invasive hemodynamic monitoring. These studies may not have relevance to patients undergoing elective ambulatory surgery. At this time, the prudent choice remains to postpone elective surgeries for at least 6 months after myocardial infarction.

Goldman et al. established a cardiac risk index [52] which has been useful in identifying patients with intermediate risk for cardiac complications in the perioperative period [53]. Patients with a score greater than 13 should be referred to a cardiologist for preoperative evaluation. Dipyridamole thallium scanning and dobutamine stress echocardiography have proven useful in predicting adverse perioperative cardiac events [72]. One reliable and simple screening method to evaluate cardiac status is exercise tolerance. The ability to increase the heart rate to 85 % of the age-adjusted maximal heart rate is a reliable predictor of perioperative cardiac morbidity [73].

Despite years of investigation, no one anesthetic technique or medication has emerged as the preferential method to reduce the incidence of perioperative complications in patients with cardiac disease [74, 75]. Regardless of which anesthesia technique is selected, scrupulous monitoring should serve as the framework for safe anesthetic management. Hemodynamic fluctuations must be avoided to prevent ischemic episodes in the perioperative period.

2.2.2 Obesity

The current prevalence of obesity in the USA is estimated to be 55 % of the population [76]. It is reasonable to assume that patients undergoing major liposuction or abdominoplasty have a greater incidence of obesity. The most widely accepted method of quantifying the level of obesity is the body mass index (BMI), which is determined by weight (kg)/height (m)2. Patients with a

BMI over 30 are considered obese, while a BMI over 35 indicates morbid obesity [77].

The risk factors associated with obesity such as diabetes mellitus, hypertension, heart disease, sleep apnea, and occult liver disease [78] should concern clinicians administering anesthesia to patients with obesity. A thorough preoperative evaluation must rule out these occult risk factors prior to elective surgery.

Anatomical abnormalities make airway control challenging [79] and endotracheal intubation hazardous [80]. The combination of a higher gastric volume and lower pH with a higher frequency of esophageal reflux results in a higher risk of pulmonary aspiration [81]. Pulmonary function can be severely restricted even in an upright position [82]. However, in the supine position, pulmonary function is further reduced [83]. Pulmonary function is further compromised in the anesthetized patient. Because of these cardiopulmonary abnormalities, obese patients develop hypoxemia more quickly [84]. This respiratory impairment may persist up to 4 days after surgery [85]. Even distribution and metabolism of medications vary significantly and often unpredictably in the obese patient [86].

Given the increased risk of perioperative morbidity and mortality of anesthesia, morbidly obese patients (BMI greater than 35) undergoing major surgery and anesthesia of any type should preferentially be restricted to a hospital based surgical facility. In general, these patients should not be considered candidates for ambulatory surgery. Anesthesia delivered in the office setting should be restricted to patients with a BMI less than 35.

Premedication with metaclopromide, a dopamine receptor antagonist, increases gastric motility and lower esophageal sphincter tone. A histamine receptor-blocking agent such as ranitidine used with metaclopromide the evening before and on the morning of surgery reduces the risk of pulmonary aspiration [87].

Because of the increased risks of deep venous thrombosis (DVT) [88] and pulmonary embolism (PE) [89], prophylactic measures such as lower extremity pneumatic compression devices and early ambulation should be used.

An undetermined number of patients self-administer herbal dietary supplements. Many of these supplements contain ephedra alkaloids, which may predispose the patient to perioperative hypertension and cardiac arrhythmias [90]. Some herbals may result in the increased incidence of bleeding from coumadin-like substances. Antiobesity medications such as aminorex fumarate, dexfenfluramine (Redux), fenfluramine (pondamin) and phentermine (Ionamin, Adipex-P, Fastin, Oby-Cap, Obenix, Oby-trim, Zantryl) are associated with pulmonary hypertension and valvular heart disease, even with as little as 2 months of use. While most patients develop symptoms such as palpitations, dyspnea, chest pain, and irregular heart rate, murmur, and edema, some patients remain asymptomatic [91].

Patients who have developed pulmonary hypertension and valvular heart disease as a result of these medications are predisposed to fatal cardiac arrhythmias, congestive heart failure, and intractable hypotension. Some authors advocate a cardiac evaluation with echocardiogram and continuous wave Doppler imaging with color-flow examination for any patient who has taken these antiobesity medications prior to surgery. Sustained hypotension may not respond to ephedrine, a popular vasopressor. Phenylephrine is the treatment of choice for hypotension in these patients [91].

2.2.3 Hypertension

Early studies revealed a significantly increased risk of perioperative mortality in patients with untreated hypertension [92, 93]. The reduction in mortality from cardiovascular and cerebral vascular disease resulting from proper treatment of hypertension has been widely accepted [94–96]. Although somewhat controversial, most authors concur that preoperative stabilization of hypertension reduces perioperative cardiovascular complications such as ischemia [97–99]. Patients with undiagnosed or poorly controlled hypertension should be identified early in the preoperative preparation process and referred to the family physician or internist for evaluation and treatment.

Physicians should not mistakenly attribute severe hypertension to the patient's preoperative anxiety.

Because of the risk of rebound hypertension, antihypertension medications should be continued up to the morning of surgery [100], except for angiotensin-converting (ACE) inhibitors, which have been associated with hypotension during induction of general anesthesia [101].

Mild to moderate perioperative hypertension may be a response to inadequate general or local anesthesia or pain control. In these cases, pain is usually accompanied by other signs, such as the patient's complaints, in the case of anesthesia for the conscious patient, tachycardia, and tachypnea. If hypertension persists despite additional local anesthetic or analgesic medication, then treatment of the blood pressure is indicated. Moderate to severe blood pressure elevations occurring during the surgery or during recovery should be treated using one or more of the antihypertensive agents available.

Perioperative hypertension, especially if the hypertension is accompanied by tachycardia, may be treated with a beta-adrenergic blocking agent such as propranolol in judiciously administered, intravenous doses of 0.5 mg at 10- to 15-min intervals. Even small doses of a beta-adrenergic blocking agent have been shown to re-

duce the incidence of cardiac ischemia [99]. Labetolol, an antihpertensive agent with combined alpha-adrenergic and beta-adrenergic blocking properties, administered in 5–10 mg doses every 10 min, is also a safe and effective alternative for treating both hypertension and tachycardia [102].

Nifedipine (10 mg s.l.), a potent systemic and coronary arteriolar dilator, effectively reduces blood pressure, and may be administered in a conscious patient. The effect of nifedipine may be additive if given with narcotics or inhalational anesthetic agents. Because nifedipine and lidocaine are both highly protein bound, caution must be exercised when administering nifedipine after high dose lidocaine tumescent anesthesia has been administered to avoid possible toxic effects of the lidocaine [103].

For severe hypertension, hydralazine, a potent vasodilator, may be useful in 2.5–5 mg doses intravenously at 10–15 min intervals. The effects of hydralazine may be delayed up to 20 min and its effects prolonged. Hydralazine may cause tachycardia or hypotension, especially if the patient is hypovolemic [104].

2.2.4 Diabetes Mellitus

Although patients with diabetes mellitus have a substantially increased surgical mortality rate than nondiabetic patients [105], these complications are more likely to be a consequence of the end-organ disease such as cardiovascular disease, renal disease, and altered wound healing [106–108]. While evidence suggests that tight control of blood sugar in insulin-dependent diabetics slows the progression of end-organ disease [109], tight control is associated with additional risks such as hypoglycemia and even death [110].

The preoperative evaluation should identify diabetic patients with poor control as well as medical conditions associated with diabetes such as cardiovascular disease and renal insufficiency. Diabetic patients have a greater incidence of silent myocardial ischemia [111]. Minimum preoperative analysis includes fasting blood sugar, glycosylated hemoglobin, electrolytes, BUN, creatinine and EKG. If any doubt exists regarding the patient's medical stability, consultation should be obtained from the diabetologist, cardiologist, or nephrologist if needed. Patients with brittle diabetes or with other coexisting medical conditions should be referred to a hospital-based surgical unit, especially if general anesthesia is contemplated.

The goal of perioperative management of stable type I or type II diabetic patients is primarily to avoid hypoglycemia. Although patients are generally NPO after midnight prior to surgery, a glass of clear juice may be taken up to 2 h prior to surgery to avoid hypoglycemia. Patients with type I diabetes should not administer insulin and patients with type II diabetes should not take the oral hypoglycemia agents on the morning of surgery. Diabetic patients should be scheduled the first case in the morning to minimize the risk of hypoglycemia during the NPO period. After the patient arrives, preoperative fasting glucose should be checked and then an infusion of 5% dextrose is generally initiated at 1–2 ml/kg/h and continued until oral fluids are tolerated in the recovery period. Usually, one-half of the patient's scheduled dose of insulin is administered after the intravenous dextrose is begun [112].

For surgeries longer than 2 h, at least one peripheral blood glucose should be measured, especially if the patient is receiving general anesthesia. Blood glucose above 200 mg/dl may be effectively managed with a sliding scale of insulin [113]. Treatment regimens directed toward tighter control of the blood sugar, such as continuous insulin infusions, do not necessarily improve the perioperative outcome [114, 115]. It is imperative that, prior to discharge, patients are able to tolerate oral intake without nausea and vomiting. A final glucose level should be checked prior to discharge.

2.2.5 Pulmonary Disease

Bronchial asthma, chronic bronchitis, chronic obstructive pulmonary disease, obesity, history of smoking, and recent upper respiratory infection are the most common medical conditions which may influence pulmonary function in the perioperative period. An estimated 4.5% of the population may suffer some form of reactive airway disease [116]. If these medical conditions are identified in the preoperative history, a thorough evaluation of the patient's pulmonary function should ensure. As with other medical conditions, a careful history may help separate patients with these medical conditions into low and high risk groups, especially since the degree of preoperative respiratory dyspnea closely correlates with postoperative mortality [117]. Using a simple grading scale, the patients' preoperative pulmonary function can be estimated (Table 2.4).

Patients with level 2 dyspnea or greater should be referred to a pulmonologist for more complete evalua-

Table 2.4. Grade of dyspnea while walking. (Adapted from Boushy et al. [117])

Level	Clinical response
0	No dyspnea
1	Dyspnea with fast walking only
2	Dyspnea with one or two blocks walking
3	Dyspnea with mild exertion (walking around the house)
4	Dyspnea at rest

tion and possibly further medical stabilization. The benefits of elective surgery in patients with level 3 and 4 dyspnea should be carefully weighed against the increased risks. Certainly, this group of patients would not be considered good candidates for outpatient surgery.

Since upper respiratory infection (URI) may alter pulmonary function for up to 5 weeks [118], major surgery requiring general endotracheal anesthesia should be postponed, especially if the patient suffers residual systems, such as fevers, chills, coughing and sputum production, until the patient is completely asymptomatic.

While many studies confirm that patients who smoke more than one to two packs of cigarettes daily have a higher risk of perioperative respiratory complications than non-smokers, cessation of smoking in the immediate preoperative period may not improve patients' outcome. In fact, patients' risk of perioperative complications may actually increase if smoking is stopped immediately prior to surgery. A full 8 weeks may be required to successfully reduce perioperative pulmonary risk [119].

If the physical examination of asthmatic patients reveals expiratory wheezing, conventional wisdom dictates that potentially reversible bronchospasm should be optimally treated prior to surgery. Therapeutic agents include inhaled or systemic, selective beta-adrenergic receptor type-2 agonists (albuterol) as a sole agent or in combination with anticholinergic (ipratropium) and locally active corticosteroid (beclomethasone dipropronate) medications [120]. Continuing the asthmatic medications up to the time of surgery [121] and postoperative use of incentive spirometry [122] has been shown to reduce postoperative pulmonary complications.

With regard to treated stable pulmonary disease, there are no conclusive, prospective, randomized studies to indicate which anesthesia technique or medications would improve patient outcome.

2.2.6 Obstructive Sleep Apnea

According to the National Commission on Sleep Disorders Research, approximately 18 million Americans suffer with obstructive sleep apnea (OSA). Unfortunately, the majority of patients with OSA remain undiagnosed [123]. The incidence of sleep apnea increases among obese patients [124]. Since the target population for major liposuction and abdominoplasty includes patients with morbid obesity, concern about OSA becomes more germane.

OSA is a result of a combination of excessive pharyngeal adipose tissue and inadequate pharyngeal soft tissue support [125]. During episodes of sleep apnea, patients may suffer significant and sustained hypoxemia. As a result of the pathophysiology of OSA, patients develop left and right ventricular hypertrophy [126]. Consequently, patients have a higher risk of ventricular dysarrhythmias and myocardial infarction [127].

Most medications used during anesthesia, including sedatives such as diazepam and midazolam, hypnotics such as propofol, and analgesics such as fentanyl, meperidine and morphine, increase the risk of airway obstruction and respiratory depression in patients with OSA [128]. Death may occur suddenly and silently in patients with inadequate monitoring [129]. A combination of anatomical abnormalities make airway management, including mask ventilation and endotracheal intubation, especially challenging in obese patients with OSA [130]. Perioperative monitoring, including visual observation, must be especially vigilant to avoid perioperative respiratory arrest in patients with OSA.

For patients with severe OSA, particularly those with additional coexisting medical conditions such as cardiac or pulmonary disease, surgery performed on an outpatient basis is not appropriate. For these high-risk patients, monitoring should continue in the intensive care unit until the patient no longer requires parenteral analgesics. If technically feasible, regional anesthesia may be preferable in patients with severe OSA. Postoperatively, patients with any history of OSA should not be discharged if they appear lethargic or somnolent [131].

During the preoperative evaluation of the obese patient, a presumptive diagnosis of OSA may be made if the patient has a history of loud snoring, long pauses of breathing during sleep, as reported by the spouse, or daytime somnolence [132]. If OSA is suspected, patients should be referred for a sleep study to evaluate the severity of the condition.

2.2.7 Malignant Hyperthermia Susceptibility

Patients with susceptibility to malignant hyperthermia (MH) can be successfully managed on an outpatient basis after 4 h of postoperative monitoring [133]. Triggering agents include volatile inhalation agents such as halothane, enflurane, desflurane, isoflurane and sevoflurane. Even trace amounts of these agents lingering in an anesthesia machine or breathing circuit may precipitate an MH crisis. Succinylcholine and chlopromazine are other commonly used medications, which are known triggers of MH. However, many non-triggering medications may be safely used for local anesthesia, sedation-analgesia, postoperative pain control, and even general anesthesia [134]. Nevertheless, anesthesia for patients suspected of having MH susceptibility should not be performed in an office-based setting. A stan-

dardized protocol to manage MH (available from the Malignant Hyperthermia Association of the United States, MHAUS) and supplies of dantrolene and cold intravenous fluids should be available for all patients.

Preferably, patients with MH susceptibility should be referred to an anesthesiologist for prior consultation. Intravenous dantrolene [135] and iced intravenous fluids are still the preferred treatment. MHAUS may be contacted at 800 – 98MHAUS and the MH hotline is 800-MH-HYPER.

2.3 Anesthesia for Liposuction and Abdominoplasty

Anesthesia may be divided into four broad categories: local anesthesia, local anesthesia combined with sedation, regional anesthesia and general anesthesia. The ultimate decision to select the type of anesthesia depends on the type and extent of the surgery planned, the patient's underlying health condition and the psychological disposition of the patient. For example, a limited liposuction of less than 500 ml of fat from a small area in a healthy patient, with limited anxiety, could certainly be performed using strictly local anesthesia without sedation. As the scope of the surgery broadens, or the patient's anxiety level increases, the local anesthesia may be supplemented with oral or parenteral analgesic or anxiolytic medication.

2.3.1 Local Anesthesia

A variety of local anesthetics are available for infiltrative anesthesia. The selection of the local anesthetic depends on the duration of anesthesia required and the volume of anesthetic needed.

The traditionally accepted, pharmacological profiles of common anesthetics used for infiltrative anesthesia for adults are summarized in Table 2.5. The maximum doses may vary widely depending on the type of tissue injected [136], the rate of administration [137], the age, underlying health, and body habitus of the patient [138], the degree of competitive protein binding [139] and the possible cytochrome inhibition of concomitantly administered medications [140]. The maximum tolerable limits of local anesthetics have been redefined with the development of the tumescent anesthetic technique [141]. Lidocaine doses up to 35 mg/kg were found to be safe, if administered in conjunction with dilute epinephrine during liposuction [142]. With the tumescent technique, peak plasma levels occur 6 – 24 h after administration [142, 143]. More recently, doses up to 55 mg/kg have been found to be within the therapeutic safety margin [144]. However, recent guidelines by the American Academy of Cosmetic Surgery recommend a maximum dose of 45 – 50 mg/kg [29].

Since lidocaine is predominantly eliminated by hepatic metabolism, specifically, cytochrome oxidase P450 34A, drugs that inhibit this microsomal enzyme may increase the potential of lidocaine toxicity [140, 145]. Table 2.6 lists some of the more common medications, which inhibit the cytochrome oxidase system. Propofol and Versed, commonly used medications for sedation and hypnosis during liposuction, are also known to be cytochrome P450 inhibitors. However, since the duration of action of these drugs is only 1 – 4 h, the potential inhibition should not interfere with lidocaine at the peak serum level 6 – 12 h later. Lorezepam is a sedative which does not interfere with cytochrome oxidase and is preferred by some authors [146].

Table 2.6. Medications inhibiting cytochrome oxidase P450 3A4 (Shiffman [140])

Amiodarone	Fluoxetine	Nifedipine
Atenolol	Itraconazole	Paroxetine
Carbamazepine	Isoniazide	Pentoxifylline
Cimetidine	Labetolol	Pindolol
Clarithromycin	Ketoconazole	Propofol
Chloramphenicol	Methadone	Propranolol
Cyclosporin	Methyprednisolone	Quinidine
Danazol	Metoprolol	Sertraline
Dexamethasone	Miconazole	Tetracyline
Diltiazam	Midazolam	Terfenidine
Erythromycin	Nadolol	Thyroxine
Fluconazole	Nefazodone	Timolol
Flurazepam	Nicardipine	Triazolam
		Verapamil

Table 2.5. Clinical pharmacology of common local anesthetics for infiltrative anesthesia. (Adapted from Covino and Wildsmith [61])

Agent	Concentration (%)	Without epinephrine Duration of action (min)			Maximum dose	With epinephrine Duration of action (min)			Maximum dose
		mg/kg total	mg total	ml		mg/kg total	mg/kg total	ml	
Lidocaine	**1.0**	**30 – 60**	**4**	**300**	**30**	**120**	**7**	**500**	**50**
Mepivacaine	1.0	45 – 90	4	300	30	120	7	500	50
Etidocaine	0.5	120 – 180	4	300	60	180	5.5	400	80
Bupivacaine	0.25	120 – 240	2.5	185	75	180	3	225	90
Ropivacaine	0.2	120 – 360	2.7	200	8	120 – 360	2.7	200	80

Certainly, significant toxicity has been associated with high doses of lidocaine as a result of tumescent anesthesia during liposuction [146]. The systemic toxicity of local anesthetic has been directly related to the serum concentration by many authors [139, 142–144, 146–148]. Early signs of toxicity, usually occurring at serum levels of about 3–4 μg/ml for lidocaine, include circumoral numbness and lightheadedness, and tinnitus. As the serum concentration increases toward 8 μg/ml, tachycardia, tachypnea, confusion, disorientation, visual disturbance, muscular twitching and cardiac depression may occur. At still higher serum levels above 8 μg/ml, unconsciousness and seizures may ensue. Complete cardiorespiratory arrest may occur between 10 and 20 μg/ml [139, 146, 147]. However, the toxicity of lidocaine may not always correlate exactly with the plasma level of lidocaine presumably because of the variable extent of protein binding in each patient and the presence of active metabolites [139] and other factors already discussed including the age, ethnicity, health, and body habitus of the patient, and additional medications.

Ropivacaine, a long lasting local anesthetic, has less cardiovascular toxicity than bupivacaine and may be a safer alternative to bupivacaine if a local anesthetic of longer duration is required [149, 150]. The cardiovascular toxicity of bupivacaine and etidocaine is much greater than that of lidocaine [149–151]. While bupivacaine toxicity has been associated with sustained ventricular tachycardia and sudden profound cardiovascular collapse [152, 153], the incidence of ventricular dysarrhythmias has not been as widely acknowledged with lidocaine or mepivacaine toxicity. In fact, ventricular tachycardia of fibrillation was not observed despite the use of supraconvulsant doses of intravenous doses of lidocaine, etidocaine, or mepivacaine in the animal model [150].

Indeed, during administration of infiltrative lidocaine anesthesia, rapid anesthetic injection into a highly vascular area or accidental intravascular injection leading to sudden toxic levels of anesthetics resulting in sudden onset of seizures or even cardiac arrest or cardiovascular collapse has been documented [154, 155]. One particularly disconcerting case presented by Christie confirms the fatal consequence of a lidocaine injection of 200 mg in a healthy patient [156]. Seizure and death occurred following a relatively low dose of lidocaine and a serum level of only 0.4 mg/100 ml or 4 μg/ml. A second patient suffered cardiac arrest with a blood level of 0.58 mg/100 ml or 5 μg/ml [156]. Although continued postmortem metabolism may artificially reduce serum lidocaine levels, the reported serum levels associated with mortality in these patients were well below the 8–20 μg/ml considered necessary to cause seizures, myocardial depression, and cardiorespiratory arrest. The 4 μg/ml level reported by Christie [156] is uncomfortably close to the maximum serum levels reported by Ostad et al. [140] of 3.4 and 3.6 μg/ml following tumescent lidocaine doses of 51.3 and 76.7 mg/kg respectively. Similar near toxic levels were reported in individual patients receiving about 35 mg/kg of lidocaine by Samdal et al. [157]. Pitman [158] reported that toxic manifestations occurred 8 h postoperatively after a total dose of 48.8 mg/kg which resulted from a 12-h plasma lidocaine level of 3.7 μg/kg. Ostad et al. [140] concludes that because of the poor correlation of lidocaine doses with the plasma lidocaine levels, an extrapolation of the maximum safe dose of lidocaine for liposuction cannot be determined. Given the devastating consequences of lidocaine toxicity, physicians must exercise extreme caution while attempting to push the acceptable safe limits to ever-higher levels of tumescent anesthesia. Physicians must consider the important variables affecting susceptibility of individual patients to lidocaine toxicity before "boldly going where no surgeon has gone before", especially since plasma lidocaine levels typically peak after the patient is at home.

Patients who report previous allergies to anesthetics may present a challenge to surgeons performing liposuction. Although local anesthetics of the aminoester class such as procaine are associated with allergic reactions, true allergic phenomena to local anesthetics of the aminoamide class, such as lidocaine, are extremely rare [158, 159]. Allergic reactions may occur to the preservative in the multidose vials. Tachycardia and generalized flushing may occur with rapid absorption of the epinephrine contained in some standard local anesthetic preparations. The development of vasovagal reactions after injections of any kind may cause hypotension, bradycardia, diaphoresis, pallor, nausea, and loss of consciousness. These adverse reactions may be misinterpreted by the patient and even the physician as allergic reactions [159]. A careful history from the patient describing the apparent reaction usually clarifies the cause. If there is still concern about the possibility of true allergy to local anesthetic, then the patient should be referred to an allergist for skin testing.

In the event of a seizure following a toxic dose of local anesthetic, proper airway management and maintaining oxygenation is critical. Seizure activity may be aborted with intravenous diazepam (10–20 mg), midazolam (5–10 mg), or thiopental (100–200 mg).

Although the ventricular arrhythmias associated with bupivacaine toxicity are notoriously intractable [152, 153], treatment is still possible using large doses of atropine, epinephrine and bretylium [161, 162]. Some studies indicate that lidocaine should not be used [163]. Pain associated with local anesthetic administration is due to the pH of the solution and may be reduced by the addition of 1 mEq of sodium bicarbonate to 10 ml of anesthetic [164].

EMLA (eutectic mixture of local anesthetics), a combination of lidocaine and prilocaine, may provide effective topical anesthesia over smaller areas such as the face. However, an occlusive dressing must be applied, and at least 60 min is required for adequate anesthesia [165]. Except for small, localized surgical procedures, topical anesthetics do not have a wide application for liposuction or abdominoplasty.

2.3.2 Sedative-Analgesic Medication (SAM)

Most liposuctions are performed with a combination of local tumescent anesthesia and supplemental sedative-analgesic medications (SAM) administered orally (p.o.), intramuscularly (i.m.), or intravenously (i.v.). Abdominoplasties performed under local or regional anesthesia generally require SAM. The goals of administering supplemental medications are to reduce anxiety (anxiolysis), the level of consciousness (sedation), unanticipated pain (analgesia), and, in some cases, to eliminate recall of the surgery (amnesia).

Sedation may be defined as the reduction of the level of consciousness usually resulting from pharmacological intervention. The level of sedation may be further divided into three broad categories, conscious sedation, deep sedation, and general anesthesia. The term conscious sedation has evolved to distinguish a lighter state of anesthesia with a higher level of mental functioning whereby the life-preserving protective reflexes are independently and continuously maintained. Furthermore, the patient is able to respond appropriately to physical and verbal stimulation [166].

Life preserving protective reflexes (LPPRs) may be defined as the involuntary physical and physiological responses that maintain the patient's life which, if interrupted, result in inevitable and catastrophic physiological consequences. The most obvious examples of LPPRs are the ability to maintain an open airway, swallowing, coughing, gagging, and spontaneous breathing. Some involuntary physical movements such as head turning or attempts to assume an erect posture may be considered LPPRs if these reflex actions occur in an attempt to improve airway patency such as expelling oropharyngeal contents. The myriad of homeostatic mechanisms to maintain blood pressure, heart function and body temperature may even be considered LPPRs.

As the level of consciousness is further depressed to the point that the patient is not able to respond purposefully to verbal commands or physical stimulation, the patient enters into a state referred to as deep sedation. In this state, there is a significant probability of loss of LPPRs. Ultimately, as total loss of consciousness occurs and the patient no longer responds to verbal command or painful stimuli, the patient enters a state of general anesthesia [166]. During general anesthesia the patient most likely loses the LPPRs.

In actual practice, the delineation between the levels of sedation becomes challenging at best. The loss of consciousness occurs as a continuum. With each incremental change in the level of consciousness, the likelihood of loss of LPPRs increases. Since the definition of conscious sedation is vague, current ASA guidelines consider the term sedation-analgesia a more relevant term than conscious sedation [25]. The term sedative-analgesic medication (SAM) has been adopted by some facilities. Monitored anesthesia care (MAC) has been generally defined as the medical management of patients receiving local anesthesia during surgery with or without the use of supplemental medications. MAC usually refers to services provided by the anesthesiologist or the Certified Registered Nurse Anesthetist (CRNA). The term "local standby" is no longer used because it mischaracterizes the purpose and activity of the anesthesiologist or CRNA.

Surgical procedures performed using a combination of local anesthetic and SAM usually have a shorter recovery time than similar procedures performed under regional or general anesthesia [167]. Using local anesthesia alone, without the benefit of supplemental medication is associated with a greater risk of cardiovascular and hemodynamic perturbations such as tachycardia, arrhythmias, and hypertension particularly in patients with preexisting cardiac disease or hypertension [168]. Patients usually prefer sedation while undergoing surgery with local anesthetics [169]. While the addition of sedatives and analgesics during surgery using local anesthesia seems to have some advantages, use of SAM during local anesthesia is certainly not free of risk. A study by the Federated Ambulatory Surgical Association concluded that local anesthesia, with supplemental medications, was associated with more than twice the number of complications than with local anesthesia alone. Furthermore, local anesthesia with SAM was associated with greater risks than general anesthesia [60]. Significant respiratory depression as determined by the development of hypoxemia, hypercarbia, and respiratory acidosis often occurs in patients after receiving minimal doses of medications. This respiratory depression persists even in the recovery period [170, 171].

One explanation for the frequency of these complications is the wide variability of patients' responses to these medications. Up to 20-fold differences in the dose requirements for some medications such as diazepam, and up to 5-fold variations for some narcotics such as fentanyl, have been documented in some patients [172, 173]. Even small doses of fentanyl as low as 2 μg/kg, considered by many physicians as subclinical, produce respiratory depression for more than 1 h in some patients [174]. Combinations of even small doses of seda-

tives, such as midazolam, and narcotics, such as fentanyl, may act synergistically (effects greater than an additive effect) in producing adverse side effects such as respiratory depression and hemodynamic instability [175]. The clearance of many medications may vary depending on the amount and duration of administration, a phenomenon known as context-sensitive half-life. The net result is increased sensitivity and duration of action to medication for longer surgical cases [176]. Because of these variations and interactions, predicting any given patient's dose response is a daunting task. Patients appearing awake and responsive may, in an instant, slip into unintended levels of deep sedation with greater potential of loss of LPPRs. Careful titration of these medications to the desired effect combined with vigilant monitoring are the critical elements in avoiding complications associated with the use of SAM.

Supplemental medication may be administered via multiple routes including oral, nasal, transmucosal, transcutaneous, intravenous, intramuscular and rectal. While intermittent bolus has been the traditional method to administer medication, continuous infusion and patient controlled delivery result in comparable safety and patient satisfaction [177, 178].

Benzodiazepines such as diazepam, midazolam and lorezepam remain popular for sedation and anxiolysis. Patients and physicians especially appreciate the potent amnestic effects of this class of medications, especially midazolam. The disadvantages of diazepam include the higher incidence of pain on intravenous administration, the possibility of phlebitis [179], and the prolonged half-life of up to 20 – 50 h. Moreover, diazepam has active metabolites which may prolong the effects of the medication even into the postoperative recovery time [180]. Midazolam, however, is more rapidly metabolized, allowing for a quicker and more complete recovery for outpatient surgery [180]. Because the sedative, anxiolytic and amnestic effects of midazolam are more profound than other benzodiazepines and the recovery is more rapid, patient acceptance is usually higher [181]. Since lorezepam is less affected by medications altering cytochrome P459 metabolism [182], it has been recommended as the sedative of choice of liposuctions which require a large dose lidocaine tumescent anesthesia [146]. The disadvantage of lorezepam is the slower onset of action and the 11 – 22 h elimination half-life, making titration cumbersome and postoperative recovery prolonged [180].

Generally, physicians who use SAM titrate a combination of medications from different classes to tailor the medications to the desired level of sedation and analgesia for each patient. Use of pre-packaged combinations of medications defeats the purpose of the selective control of each medication. Typically, sedatives such as the benzodiazepines are combined with narcotic analgesics such as fentanyl, meperidine, or morphine during local anesthesia to decrease pain associated with local anesthetic injection or unanticipated breakthrough pain. Fentanyl has the advantage of rapid onset and duration of action of less than 60 min. However, because of synergistic action with sedative agents, even doses of 25 – 50 μg can result in respiratory depression [183]. Other medications with sedative and hypnotic effects such as a barbiturate, ketamine, or propofol are often added. Adjunctive analgesics such as ketorolac may be administered for addition of analgesic activity. As long as the patient is carefully monitored, several medications may be titrated together to achieve the effects required for the patient characteristics and the complexity of the surgery. Fixed combinations of medications are not advised [25].

More potent narcotic analgesics with rapid onset of action and even shorter duration of action than fentanyl include sufenanil, alfenanil, and remifenanil and may be administered using intermittent boluses or continuous infusion in combination with other sedative or hypnotic agents. However, extreme caution and scrupulous monitoring is required when these potent narcotics are used because of the risk of respiratory arrest [184, 185]. Use of these medications should be restricted to the anesthesiologist or the CRNA. A major disadvantage of narcotic medication is the perioperative nausea and vomiting [186].

Many surgeons feel comfortable administering SAM to patients. Others prefer to use the services of an anesthesiologist or CNRA. Prudence dictates that for prolonged or complicated surgeries or for patients with significant risk factors, the participation of the anesthesiologist or CRNA during MAC anesthesia is preferable. Regardless of who administers the anesthetic medications, the monitoring must have the same level of vigilance.

Propofol, a member of the alkylphenol family, has demonstrated its versatility as a supplemental sedative-hypnotic agent for local anesthesia and of regional anesthesia. Propofol may be used alone or in combination with a variety of other medications. Rapid metabolism and clearance results in faster and more complete recovery with less postoperative hangover than other sedative-hypnotic medications such as midazolam and methohexital [187, 188]. The documented antiemetic properties of propofol yield added benefits of this medication [189]. The disadvantages of propofol include pain on intravenous injection and the lack of amnestic effect [190]. However, the addition of 3 ml of 2% lidocaine to 20 ml of propofol virtually eliminates the pain on injection with no added risk. If an amnestic response is desired, a small dose of a benzodiazepine, such as midazolam (5 mg i.v.), given in combination with propofol, provides the adequate amnesia. Rapid administration of propofol may be associated with significant hypotension, decreased cardiac output [191],

and respiratory depression [192]. Continuous infusion with propofol results in a more rapid recovery than similar infusions with midazolam [193]. Patient-controlled sedation with propofol has also been shown to be safe and effective [194].

Barbiturate sedative-hypnotic agents such as thiopental and methohexital, while older, still play a role in many clinical settings. In particular, methohexital, with controlled boluses (10 – 20 mg i.v.) or limited infusions remain a safe and effective sedative-hypnotic alternative with rapid recovery. However, with prolonged administration, recovery from methohexital may be delayed compared to propofol [195].

Ketamine, a phencyclidine derivative, is a unique agent because of its combined sedative and analgesic effects and the absence of cardiovascular depression in healthy patients [196]. Because the CNS effects of ketamine results in a state similar to catatonia, the resulting anesthesia is often described as dissociative anesthesia. Although gag and cough reflexes are more predictably maintained with ketamine, emesis and pulmonary aspiration of gastric contents is still possible [197]. Unfortunately, a significant number of patients suffer distressing postoperative psychomimetic reactions [198]. While concomitant administration of benzodiazepines attenuates these reactions, the postoperative psychological sequelae limit the usefulness of ketamine for most elective outpatient surgeries.

Droperidol, a butyrophenone and a derivative of haloperidol, acts as a sedative, hypnotic, and antiemetic medication. Rather than causing global CNS depression like barbiturates, droperidol causes more specific CNS changes similar to phenothiazines. For this reason, the cataleptic state caused by droperidol is referred to as neuroleptic anesthesia [199]. Droperidol has been used effectively in combination with various narcotic medications. Innovar is a combination of droperidol and fentanyl. While droperidol has a minimal effect on respiratory function if used as a single agent, when combined with narcotic medication, a predictable dose-dependent respiratory depression may be anticipated [200]. Psychomimetic reactions such as dysphoria or hallucinations are frequent, unpleasant side effects of droperidol. Benzodiazepines or narcotics reduce the incidence of these unpleasant side effects [201]. Extrapyramidal reactions such as dyskinesias, torticollis, or oculogyric spasms may also occur, even with small doses of droperidol. Dimenhydrinate usually reverses these complications [202]. Hypotension may occur as a consequence of droperidol's alpha-adrenergic blocking characteristics. One rare complication of droperidol is the neurolept malignant syndrome (NMS) [203], a condition very similar to malignant hyperthermia, characterized by extreme temperature elevations and rhabdomyolysis. The treatment of NMS and malignant hyperthermia is essentially the same. While droperidol has been used for years without appreciable myocardial depression [201], a surprising announcement from the Federal Drug Administration warned of sudden cardiac death resulting after the administration of standard, clinically useful doses [204]. Unfortunately, this potential complication makes the routine use of this once very useful medication difficult to justify given the presence of other alternative medications.

Butorphanol, buprenorphine, and nalbuphine are three synthetically derived opiates, which share the properties of being mixed agonist-antagonist at the opiate receptors. These medications are sometimes preferred as supplemental analgesics during local, re-

Medication	Bolus dose	Average adult dose	Continuous infusion rate (μg/kg/min)
Narcotic analgesics			
Alfentanil	5 – 7 μg/kg	30 – 50 μg	0.2 – 0.5
Fentanyl	0.3 – 0.7 μg/kg	25 – 50 μg	0.01
Meperidine	0.2 mg	10 – 20 mg i.v., 50 – 100 mg i.m.	NA
Morphine	0.02 mg	1 – 2 mg i.v., 5 – 10 mg i.m.	NA
Remifentanil	0.5 – 1.0 μg/kg	10 – 25 μg	0.025 – 0.05
Sufentanil	0.1 – 0.2 μg/kg	10 μg	0.001 – 0.002
Opiate agonist-antagonist analgesics			
Buprenorphene	4 – 6 μg/kg	0.3 mg	NA
Butorphanol	2 – 7 μg/kg	0.1 – 0.2 mg	NA
Nalbuphine	0.03 – 0.1 mg/kg	10 mg	NA
Sedative hypnotics			
Diazepam	0.05 – 0.1 mg/kg	5 – 7.5 mg	NA
Methohexital	0.2 – 0.5 mg/kg	10 – 20 mg	10 – 50
Midazolam	30 – 75 μg/kg	2.5 – 5.0	0.25 – 0.5
Propofol	0.2 – 0.5 mg/kg	10 – 20 mg	10 – 50
Thiopental	0.5 – 1.0 mg/kg	25 – 50 mg	50 – 100
Dissociative anesthetics			
Ketamine	0.2 – 0.5 mg/kg	10 – 20 mg	10

Table 2.7. Common medications and dosages used for sedative analgesia. These doses may vary depending on age, gender, underlying health status, and other concomitantly administered medications. (Adapted from Philip [214], SaRego et al. [215], and Fragen [216])

gional, or general anesthesia, because they partially reverse the analgesic and respiratory depressant effects of other narcotics. While these medications result in respiratory depression at lower doses, a ceiling effect occurs at a higher dose, thereby limiting the respiratory depression. Still, respiratory arrest is possible, especially if these medications are combined with other medications with respiratory depressant properties [205]. While the duration of action of butorphanol is 2–3 h, nalbuphine has a duration of action of about 3–6 h and buprenorphan up to 10 h, making these medications less suitable for surgeries of shorter duration. Table 2.7 summarizes the recommended doses for SAM.

2.3.3 General Anesthesia

While some authors attribute the majority of complications occurring during and after liposuction to the administration of systemic anesthesia [148, 206], others consider sedation and general anesthesia safe and appropriate alternatives in indicated cases [19, 158, 207, 208]. In fact, Klein correctly acknowledges that most of the complications attributed to midazolam and narcotic combinations occurred as a result of inadequate monitoring [148]. Although significant advances have been made in the administration of local anesthetics and supplemental medications, the use of general anesthesia may still be the anesthesia technique of choice for many patients. General anesthesia is especially appropriate when working with patients suffering extreme anxiety, high tolerance to narcotic or sedative medications, or if the surgery is particularly complex. The goals of a general anesthetic are a smooth induction, a prompt recovery, and minimal side effects, such as nausea, vomiting, or sore throat. The inhalation anesthetic agents, halothane, isoflurane, and enflurane, remain widely popular because of the safety, reliability, and convenience of use. The newer inhalation agents, sevoflurane and desflurane, share the added benefit of prompt emergence [209, 210]. Nitrous oxide, a longtime favorite anesthetic inhalation agent, may be associated with postoperative nausea and vomiting [211]. Patients receiving nitrous oxide also have a greater risk of perioperative hypoxemia.

The development of potent, short-acting sedative opiates, analgesics, and muscle relaxant medications has resulted in a newer medication regimen that permits the use of intravenous agents exclusively. The same medications that have been discussed for SAM can also be used during general anesthesia as sole agents or in combination with the inhalation agents [212]. The anesthesiologist or CRNA should preferentially be responsible for the administration and monitoring of a general anesthesia.

Airway control is a key element in the management of the patient under general anesthesia. Maintaining a patent airway, ensuring adequate ventilation, and prevention of aspiration of gastric contents are the goals of successful airway management. For shorter cases, the airway may be supported by an oropharyngeal airway and gas mixtures delivered by an occlusive mask. For longer or more complex cases, or if additional facial surgery is planned requiring surgical field avoidance, then the airway may be secured using laryngeal mask anesthesia (LMA) or endotracheal intubation [213].

2.3.4 Preoperative Preparation

Generally, medications, which may have been required to stabilize the patient's medical conditions, should be continued up to the time of surgery. Notable exceptions include anticoagulant medications, monoamine oxidase inhibitors (MAO) [217, 218], and possibly the angiotensin converting enzyme (ACE) inhibitor medications [219, 220]. It is generally accepted that MAO inhibitors, carboxazid (Marplan), deprenyl (Eldepryl), pargyline (Eutonyl), phenelzine (Nardil), tranylcypromine (Parnate), be discontinued 2–3 weeks prior to surgery, especially for elective cases, because of the interactions with narcotic medication, specifically hyperpyrexia, and certain vasopressor agents, specifically ephedrine [217, 218]. Patients taking ACE inhibitors (captopril, enalapril, and lisinopril) may have a greater risk for hypotension during general anesthesia [220]. As previously discussed, diabetics may require a reduction in dosage of their medication. However, if the risks of discontinuing any of these medications outweigh the benefits of the proposed elective surgery, the patient and physician may decide to postpone, modify, or cancel the proposed surgery.

Previous requirements of complete preoperative fasting for 10–16 h are considered unnecessary by many anesthesiologists [221, 222]. More recent investigations have demonstrated that gastric volume may be less 2 h after oral intake of 8 ounces of clear liquid than after more prolonged fasting [223]. Furthermore, prolonged fasting may increase the risk of hypoglycemia [224]. Many patients appreciate an 8 ounce feeding of their favorite caffeinated elixir 2 h prior to surgery. Preoperative sedative medications may also be taken with a small amount of water or juice. Abstinence from solid food ingestion for 10–12 h prior to surgery is still recommended. Liquids taken prior to surgery must be clear [225], e.g., coffee without cream or juice without pulp.

Healthy outpatients are no longer considered higher risk for gastric acid aspiration, and therefore routine use of antacids, histamine type-2 (H2) antagonists, or gastrokinetic medications is not indicated. However,

patients with marked obesity, hiatal hernia, or diabetes mellitus have higher risks for aspiration. These patients may benefit from selected prophylactic treatment [226]. Sodium citrate, an orally administered, non-particulate antacid, rapidly increases gastric pH. However, its unpleasant taste and short duration of action limits its usefulness in elective surgery [227]. Gastric volume and pH may be effectively reduced by H2 receptor antagonists. Cimetidine (300 mg p.o., 1 – 2 h prior to surgery) reduces gastric volume and pH. However, cimetidine is also a potent cytochrome oxidase inhibitor and may increase the risk of reactions to lidocaine during tumescent anesthesia [228]. Ranitidine (150 – 300 mg 90 – 120 min prior to surgery) [229] or famotidine (20 mg p.o. 60 min prior to surgery) are equally effective but have a better safety profile than cimetidine [230].

Omeprazole, which decreases gastric acid secretion by inhibiting the proton pump mechanism of the gastric mucosa, may prove to be a safe and effective alternative to the H2 receptor antagonists [230]. Metaclopramide (10 – 20 mg p.o. or i.v.), a gastrokinetic agent, which increases gastric motility and lower esophageal sphincter tone, may be effective in patients with reduced gastric motility, such as diabetics or patients receiving opiates. However, extrapyramidal side effects limit the routine use of the medication [231, 232].

Postoperative nausea and vomiting (PONV) remains one of the more vexing complications of anesthesia and surgery [233]. In fact, patients dread PONV more than any other complication, even postoperative pain [234]. PONV is the most common postoperative complication [235, 236] and the common cause of postoperative patient dissatisfaction [237]. Use of prophylactic antiemetic medication has been shown to reduce the incidence of PONV [238]. Even though many patients do not suffer PONV in the recovery period after ambulatory anesthesia, more than 35 % of patients develop PONV after discharge [239].

Droperidol, 0.625 – 1.25 mg i.v., is an extremely cost-effective antiemetic [240]. However, troublesome side effects such as sedation, dysphoria, extrapyramidal reactions [241], and more recently cardiac arrest have been described [203]. These complications may preclude the widespread use of droperidol altogether. Ondansetron, a seratonin antagonist (4 – 8 mg i.v.), is one of the most effective antiemetic medications available without sedative, dysphoric or extrapyramidal sequelae [242, 243]. The antiemetic effects of ondansetron may reduce PONV for up to 24 h postoperatively [244]. The effects of ondansetron may be augmented by the addition of dexamethasone (4 – 8 mg) [245] or droperidol (1.25 mg i.v.) [246]. Despite its efficacy, cost remains a prohibitive factor in the routine prophylactic use of ondansetron, especially in the office setting. Ondansetron is available in a parenteral preparation and as orally disintegrating tablets and oral solution.

Promethazine (12.5 – 25 mg p.o., p.r., or i.m.) and chlorpromazine (5 – 10 mg p.o., or i.m. and 25 mg p.r.) are two older phenothiazines which are still used by many physicians as prophylaxis, especially in combination with narcotic analgesics. Once again, sedation and extrapyramidal effects may complicate the routine prophylactic use of these medications [232].

Preoperative atropine (0.4 mg i.m.), glycopyrrolate, (0.2 mg i.m.), and scopolamine (0.2 mg i.m.), anticholinergic agents once considered standard preoperative medication because of their vagolytic and antisialogic effects, are no longer popular because of side effects such as dry mouth, dizziness, tachycardia, and disorientation [247]. Transdermal scopolamine, applied 90 min prior to surgery, effectively reduces PONV. However, the incidence of dry mouth and drowsiness is high [248], and toxic psychosis is a rare complication [249]. Antihistamines, such as dimenhydrinate (25 – 50 mg p.o., i.m., or i.v.) and hydroxyzine (50 mg p.o. or i.m.), may also be used to treat and prevent PONV with few side effects except for possible postoperative sedation [250].

The selection of anesthetic agents may also play a major role in PONV. The direct antiemetic actions of propofol have been clearly demonstrated [251]. Anesthetic regimens utilizing propofol, alone or in combination with other medications, are associated with significantly less PONV [252]. Although still controversial, nitrous oxide is considered by many authors a prime suspect among possible causes of PONV [211, 253, 254]. Use of opiates is also considered a culprit in the development of PONV and the delay of discharge after outpatient surgery [186, 255 – 257]. Adequate fluid hydration has been shown to reduce PONV [258].

One goal of preoperative preparation is to reduce patients' anxiety. Many simple, non-pharmacological techniques may be extremely effective in reassuring both patients and families, starting with a relaxed, friendly atmosphere and a professional, caring, and attentive office staff. With proper preoperative preparation, pharmacological interventions may not even be necessary. However, a variety of oral and parenteral anxiolytic-sedative medications are frequently called upon to provide a smooth transition to the operative room. Diazepam (5 – 10 mg p.o.), given 1 – 2 h preoperatively, is a very effective medication, which usually does not prolong recovery time [259]. Parenteral diazepam (5 – 10 mg i.v. or i.m.) may also be given immediately preoperatively. However, because of a long elimination half-life of 24 – 48 h, and active metabolites with an elimination half-life of 50 – 120 h, caution must be exercised when using diazepam, especially in shorter cases, so that recovery is not delayed [260]. Pain and phlebitis with i.v. or i.m. administration reduces the popularity of diazepam [179].

Lorezepam (1 – 2 mg p.o. or s.l., 1 – 2 h preoperatively) is also an effective choice for sedation or anxiolysis. However, the prolonged duration of action may prolong recovery time after shorter cases [261]. Midazolam (5 – 7.5 mg i.m., 30 min preoperatively, or 2 mg i.v. minutes prior to surgery) is a more potent anxiolytic-sedative medication with more rapid onset and shorter elimination half-life, compared to diazepam [262]. Unfortunately, oral midazolam has unpredictable results and is not considered a useful alternative for preoperative medication [263]. Oral narcotics, such as oxycodone (5 – 10 mg p.o.), may help relieve the patient's intraoperative breakthrough pain during cases involving more limited liposuction with minimal potential perioperative sequelae. Parenteral opioids, such as morphine (5 – 10 mg i.m., or 1 – 2 mg i.v.), demerol (50 – 100 mg i.m., or 10 – 20 mg i.v.), fentanyl (10 – 20 μg i.v.), or sufentanil (1 to 2 ug i.v.), may produce sedation and euphoria and may decrease the requirements for other sedative medication. The level of anxiolysis and sedation is still greater with the benzodiazepines than with the opioids. Premedication with narcotics has been shown to have minimal effects on postoperative recovery time. However, opioid premedication may increase PONV [264, 265].

Antihistamine medications, such as hydroxyzine (50 – 100 mg i.m, or 50 – 100 mg p.o.), dimenhydrinate (50 mg p.o., i.m., or 25 mg i.v.), are still used safely in combination with other premedications, especially the opioids, to add sedation and to reduce nausea and pruritis. However, the anxiolytic and amnestic effects are not as potent as the benzodiazepines [266]. Barbiturates, such as secobarbital and pentobarbital, once a standard premedication have largely been replaced by the benzodiazepines.

Postoperative PE is an unpredictable and devastating complication with an estimated incidence of 0.1 – 5 %, depending on the type of surgical case [267], and a mortality rate of about 15 % [267]. Risk factors for thromboembolism include prior history or family history of DVT or PE, obesity, smoking, hypertension, use of oral contraceptives and hormone replacement therapy, and patients over 60 years of age [268]. Estimates for the incidence of postoperative DVT vary between 0.8 % for outpatients undergoing herniorrhaphies [269], to up to 80 % for patients undergoing total hip replacement [267]. Estimates of fatal PE also vary from 0.1 % for patients undergoing general surgeries to up to 1 – 5 % of patients undergoing major joint replacement [267]. While a recent national survey of physicians performing tumescent liposuction, in a total of 15,336 patients, indicated that no patient suffered DVT or PE [270], only 66 physicians who perform liposuction responded out of 1,778 questionnaires sent, which is a mere 3.7 % response rate. A review of 26,591 abdominoplasties revealed 9 cases of fatal PE, or 0.03 %, but gave no information regarding the incidence of non-fatal PE [271]. Other reports suggest that the incidence of pulmonary embolism after tumescent liposuction and abdominoplasty may be more common than reported [272 – 275]. One study revealed that unsuspected PE may actually occur in up to 40 % of patients who develop DVT [276].

Prevention of DVT and PE should be considered an essential component of the perioperative management. Although unfractionated heparin reduces the rate of fatal PE [277], many surgeons are reluctant to use this prophylaxis because of concerns of perioperative hemorrhage. The low molecular weight heparins, enoxaparin, dalteparin, ardeparin, and danaparoid, a heparinoid, are available for prophylactic indications. Graduated compression stockings and intermittent pneumatic lower extremity compression devices applied throughout the perioperative period, until the patient has become ambulatory, are considered very effective and safe alternatives in the prevention of postoperative DVT and PE [278, 279]. Even with prophylactic therapy, PE may still occur up to 30 days after surgery [280]. Physicians should be suspicious of PE if patients present postoperatively with dyspnea, chest pain, cough, hemoptysis, pleuritic pain, dizziness, syncope, tachycardia, cyanosis, shortness of breath, or wheezing [268].

2.3.5 Perioperative Monitoring

The adoption of a standardized perioperative monitoring protocol has resulted in a quantum leap in perioperative patient safety. The standards for basic perioperative monitoring were approved by the ASA in 1986 and amended in 1995 [17]. These monitoring standards are now considered applicable to all types of anesthetics, including local with or without sedation, regional, or general anesthesia, regardless of the duration or complexity of the surgical procedure and regardless of whether the surgeon or anesthesiologist is responsible for the anesthesia. Vigilant and continuous monitoring and compulsive documentation facilitates early recognition of deleterious physiological events and trends, which, if not recognized promptly, could lead to irreversible pathological spirals, ultimately endangering a patient's life.

During the course of any anesthetic, the patient's oxygenation, ventilation, circulation, and temperature should be continuously evaluated. The concentration of the inspired oxygen must be measured by an oxygen analyzer. Assessment of the perioperative oxygenation of the patient using pulse oximetry, now considered mandatory in every case, has been a significant advancement in monitoring. This monitor is so critical to the safety of the patient that it has earned the nickname "the monitor of life". Evaluation of ventilation includes

observation of skin color, chest wall motion, and frequent auscultation of breath sounds. During general anesthesia with or without mechanical ventilation, a disconnect alarm on the anesthesia circuit is crucial. Capnography, a measurement of respiratory end-tidal CO_2, is required, especially when the patient is under heavy sedation or general anesthesia. Capnography provides the first alert in the event of airway obstruction, hypoventilation, or accidental anesthesia circuit disconnect, even before the oxygen saturation has begun to fall. All patients must have continuous monitoring of the electrocardiogram (ECG), and intermittent determination of blood pressure (BP) and heart rate (HR) at a minimum of 5-min intervals. Superficial or core body temperature should be monitored. Of course, all electronic monitors must have preset alarm limits to alert physicians prior to the development of critical changes.

While the availability of electronic monitoring equipment has improved perioperative safety, there is no substitute for visual monitoring by a qualified, experienced practitioner, usually a CRNA or an anesthesiologist. During surgeries using local with SAM, if a surgeon elects not to use a CRNA or an anesthesiologist, a separate, designated, certified individual must perform these monitoring functions [25]. Visual observation of the patient's position is also important in order to avoid untoward outcomes such as peripheral nerve or ocular injuries.

Documentation of perioperative events, interventions, and observations must be contemporaneously performed and should include BP and HR every 5 min and oximetry, capnography, ECG pattern, and temperature at 15-min intervals. Intravenous fluids, medication dosages in milligrams, patient position and other intraoperative events must also be recorded. Documentation may alert the physician to unrecognized physiological trends that may require treatment. Preparation for subsequent anesthetics may require information contained in the patient's prior records, especially if the patient suffered an unsatisfactory outcome due to the anesthetic regimen that was used. Treatment of subsequent complications by other physicians may require information contained in the records, such as the types of medications used, blood loss or fluid totals. Finally, compulsive documentation may help exonerate a physician in many medical-legal situations.

When local anesthesia with SAM is used, monitoring must include an assessment of the patient's level of consciousness as previously described. For patients under general anesthesia, the level of consciousness may be determined using the bispectral index (BIS), a measurement derived from computerized analysis of the electroencephalogram. When used with patients receiving general anesthesia, BIS improves control of the level of consciousness, rate of emergence and recovery, and cost-control of medication usage [281].

2.3.6 Fluid Replacement

Management of perioperative fluids probably generates more controversy than any other anesthesia related topics. Generally, the typical, healthy, 60-kg patient requires about 100 cc of water per hour to replace metabolic, sensible, and insensible water losses. After a 12-h period of fasting, a 60-kg patient may be expected to have a 1-liter volume deficit on the morning of surgery. This deficit should be replaced over the first few hours of surgery. The patient's usual maintenance fluid needs may be met with a crystalloid solution such as lactated Ringer's solution.

Replacement fluids may be divided into crystalloid solutions, such as normal saline or balanced salt solution, colloids, such as fresh frozen plasma, 5% albumin, plasma protein fraction, or hetastarch, and blood products containing red blood cells, such as packed red blood cells. Generally, balanced salt solutions may be used to replace small amounts of blood loss. For every milliliter of blood loss, 3 ml of fluid replacement is usually required [282]. However, as larger volumes of blood are lost, attempts to replace these losses with crystalloid reduces the serum oncotic pressure, one of the main forces supporting intravascular volume. Subsequently, crystalloid rapidly moves into the extracellular space. Intravascular volume cannot be adequately sustained with further crystalloid infusion [283]. At this point, many authors suggest that a colloid solution may be more effective in maintaining intravascular volume and hemodynamic stability [284, 285]. Given the ongoing crystalloid-colloid controversy in the literature, the most practical approach to fluid management is a compromise. Crystalloid replacement should be used for estimated blood losses (EBL) less than 500 ml, while colloids such as hetastarch may be used for EBLs greater than 500 ml. One milliliter of colloid should be used to replace 1 ml of EBL [282]. However, not all authors agree on the benefits of colloid resuscitation. Moss and Gould concluded that isotonic crystalloid replacement, even for large EBLs, restores plasma volume as well as colloid replacement [286].

For patients with less than 1,500 ml of fat extraction using the tumescent technique, studies have determined that postoperative serum hemoglobin remains essentially unchanged [287]. Therefore, intravenous fluids beyond the deficit replacement and the usual maintenance amounts are generally not required [19, 158, 287, 288]. As the volume of fat removed approaches or exceeds 3,000 cc, judicious intravenous fluid replacement, including colloid, may be considered, depending on the patient's hemodynamic status [19]. Fluid overload with the possibility of pulmonary edema and congestive heart failure following aggressive administration of infusate and intravenous crystalloid

solutions has become a legitimate concern [158, 288–292]. Using the tumescent technique during which subcutaneous infusion ratios are 2–3 ml for 1 ml of fat aspirated, significant intravascular hemodilution has been observed [289]. A 5-liter tumescent infusion may result in a hemodilution of 10%. Plasma lidocaine near toxic levels, combined with an increased intravascular volume, may increase the risk of cardiogenic pulmonary edema, even in healthy patients [139].

While crystalloid replacement regimen may vary, Pitman et al. [290] advocates limiting i.v. replacement to the difference between twice the volume of total aspirate and the sum of i.v. fluid already administered intravenously and as tumescent infusate. This replacement formula presumes a ratio of infusate to aspirate of greater than 2 to 1. If the ratio is less than one, more generous replacement fluids may be required since hypovolemia may occur [291]. The determination of fluid replacement is still not an exact science, by any means. Because of the unpredictable fluid requirements in patients, careful monitoring is required, including possible laboratory analysis such as CBC, BUN [291].

The estimation of perioperative blood and fluid loss during liposuction and abdominoplasty surgeries is not a trivial task. Observers in the same room frequently have wide discrepancies in the estimated blood loss. In the case of the abdominoplasty, unrecognized blood loss occurs. Substantial amounts of blood typically seep around and under the patient, unnoticed by the surgeon, only to be discovered later as the nurses apply the dressing. Because of subcutaneous hematoma formation and the difficulty of measuring the blood content in the aspirate, estimating the EBL during liposuction may be a particularly daunting task. Fortunately, the development of tumescent technique has dramatically reduced perioperative blood loss during liposuction surgeries [24, 293].

The blood content in the aspirate after tumescent liposuction has varied between less than 1% [288, 293] and 8% [290]. To underscore the difficulty of estimating the EBL, the range of the determined blood loss in one study was 0–1,002 ml or 0–41.5% of the aspirate for liposuctions removing 1,000–5,500 ml of fat [290]. Samdal et al. [293] admitted that the mean fall of postoperative hemoglobin of 5.2% (±4.9%) was higher than anticipated. The author suggested that previous estimates of continued postoperative blood extravasation into the surgical dead space may be too low and may be greater than the EBL identified in the aspirate. Mandel [294] concluded that unappreciated blood loss continues for several days after surgery, presumably due to soft tissue extravasation, and that serial postoperative hematocrit determinations should be used, especially for large volume liposuctions.

The decision to transfuse a patient involves multiple considerations. Certainly, the EBL, health, age, and estimated preoperative blood volume of the patient, and the hemodynamic stability of the patient are the primary concerns. The potential risks of transfusions, such as infection, allergic reaction, errors in cross matching, and blood contamination should be considered. Finally, the patient's personal or religious preferences may play a pivotal role in the decision to transfuse. Cell saving devices and autologous blood transfusions may alleviate many of these concerns. Healthy, normovolemic patients, with hemodynamic and physiologic stability, should tolerate hemoglobin levels down to 7.5 g/dl [295]. Even for large volume liposuction using the tumescent technique, transfusions are rarely necessary [19]. Once the decision to transfuse is made, 1 ml of RBCs should be used to replace every 2 ml of EBL [282]. Serial hematocrit determination, although sometimes misleading in cases of fluid overload and hemodilution, is still considered an important diagnostic tool in the perioperative period to assist with decisions regarding transfusion.

During abdominoplasty and large volume liposuction monitoring the urine output using an indwelling urinary catheter is a useful guide to the patient's volume status. Urinary output should be maintained at greater than 0.5 ml/kg per hour. However, urinary output is not a precise method of determining the patient's volume status since other factors, including surgical stress, hypothermia, and the medications used during anesthesia are known to alter urinary output [296]. Therapeutic determinations based on a decreased urinary output must also consider other factors, since oliguria may be a result of either hypovolemia or fluid overload and congestive heart failure. In general, use of loop diuretics, such as furosemide, to accelerate urinary output, makes everyone in the room feel better, but does little to elucidate the cause of the reduced urinary output, and in cases of hypovolemia may worsen the patient's clinical situation. However, a diuretic may be indicated if oliguria develops in the course of large volume liposuction where the total infusate and intravenous fluids are several liters more than the amount of aspirate [292].

The same intensive monitoring and treatment which occurs in the operating room must be continued in the recovery room under the care of a designated, licensed, and experienced person for as long as is necessary to ensure the stability and safety of the patient, regardless of whether the facility is a hospital, an outpatient surgical center, or a physician's office. During the initial stages of recovery, the patient should not be left alone while hospital or office personnel attend to other duties. Vigilant monitoring including visual observation, continuous oximetry, continuous ECG, and intermittent BP and temperature determinations must be continued. Because the patient is still vulnerable to airway obstruction and respiratory arrest in the recovery peri-

od, continuous visual observation is still the best method of monitoring for this complication. Supplemental oxygenation should be continued during the initial stages of recovery and continued until the patient is able to maintain an oxygen saturation above 90% on room air.

The most common postoperative complication is nausea and vomiting. The antiemetic medications previously discussed, with the same consideration of potential risks, may be used in the postoperative period. Because of potential cardiac complications, droperidol, one of the most commonly used antiemetics, is now considered unsafe unless the patient has no cardiac risk factors and a recent 12-lead ECG is normal [68]. Ondansetron (4–8 mg i.v. or s.l.) is probably the most effective and safe antiemetic. However, the cost of this medication is often prohibitive, especially in an office setting. Postoperative surgical pain may be managed with judiciously titrated i.v. narcotic medication such as demerol (10–20 mg i.v. every 5–10 min), morphine (1–2 mg i.v. every 5–10 min), or butorphanol (0.1–0.2 mg i.v. every 10 min).

Following large volume liposuction, extracellular fluid extravasation or third spacing may continue for hours postoperatively leading to the risk of hypotension, particularly if the ratio of tumescent infusate to aspirate is less than one [292]. For large volume liposuction, blood loss may continue for 3–4 days [294]. Crystalloid or colloid replacement may be required in the event of hemodynamic instability.

The number of complications that occur after discharge may be more than twice the complications occurring intraoperatively and during recovery combined [297]. Accredited ambulatory surgical centers generally have established discharge criteria. While these criteria may vary, the common goal is to ensure the patient's level of consciousness and physiological stability. Table 2.8 is one example of discharge criteria that may be used:

Table 2.8. Ambulatory discharge criteria. (Modified from Mecca [298])

1	All life-preserving protective reflexes, i.e., airway, cough, gag, must be returned to normal
2	The vital signs must be stable without orthostatic changes
3	There must be no evidence of hypoxemia 20 min after the discontinuation of supplemental oxygen
4	Patients must be oriented to person, place, time, and situation (times 4)
5	Nausea and vomiting must be controlled and patients should tolerate p.o. fluids
6	There must be no evidence of postoperative hemorrhage or expanding ecchymosis
7	Incisional pain should be reasonably controlled
8	The patient should be able to sit up without support and walk with assistance

Use of medication intended to reverse the effects of anesthesia should be used only in the event of suspected overdose of medications. Naloxone (0.1–0.2 mg i.v.), a pure opiate receptor antagonist, with a therapeutic half-life of less than 2 h, may be used to reverse the respiratory depressant effects of narcotic medications, such as morphine, demerol, fentanyl, and butorphanol. Because potential adverse effects of rapid opiate reversal of narcotics include severe pain, seizures, pulmonary edema, hypertension, congestive heart failure, and cardiac arrest [299], naloxone must be administered by careful titration. Naloxone has no effect on the actions of medications, such as the benzodiazepines, the barbiturates, propofol, or ketamine.

Flumazenil (0.1–0.2 mg i.v.), a specific competitive antagonist of the benzodiazepines, such as diazepam, midazolam, lorezepam, may be used to reverse excessive or prolonged sedation and respiratory depression resulting from these medications [300]. The effective half-life of flumazenil is l h or less [301].

The effective half-lives of many narcotics exceed the half-life of naloxone. The benzodiazepines have effective half-lives greater than 2 h and, in the case of diazepam, up to 50 h. Many active metabolites unpredictably extend the putative effects of the narcotics and benzodiazepines. A major risk associated with the use of naloxone and flumazenil is the recurrence of the effects of the narcotic or benzodiazepine after 1–2 h. If the patient has already been discharged to home after these effects recur, the patient may be at risk for oversedation or respiratory arrest [299, 302]. Therefore, routine use of reversal agents, without specific indication, prior to discharge is ill advised. Patients should be monitored for at least 2 h prior to discharge if these reversal agents are administered [25].

Physostigmine (1.25 mg i.v.), a centrally acting anticholinesterase inhibitor, functions as a non-specific reversal agent which may be used to counteract the agitation, sedation, and psychomotor effects caused by a variety of sedative, analgesic, and inhalation anesthetic agents [303, 304]. Neuromuscular blocking drugs, if required during general anesthesia, are usually reversed by the anesthesiologist or CRNA prior to emergence in the operating room with anticholinesterase inhibitors such as neostigmine or edrophonium. Occasionally, a second dose may be required when the patient is in the recovery room.

In the event patients fail to regain consciousness during recovery, reversal agents should be administered. If no response occurs, the patient should be evaluated for other possible causes of unconsciousness, including hypoglycemia, hyperglycemia, cerebral vascular accidents, or cerebral hypoxia. If hemodynamic instability occurs in the recovery period, causes such as occult hemorrhage, hypovolemia, pulmonary edema, congestive heart failure, or myocardial infarction must

be considered. Access to laboratory analysis to assist with the evaluation of the patient is crucial. Unfortunately, stat laboratory analysis is usually not available if the surgery is performed in an office-based setting.

The above text is meant to serve as an overview of the extremely complex subject of anesthesia. It is the intent of this chapter to serve as an introduction to the physician who participates in the perioperative management of patients and should not be considered a comprehensive presentation. The physician is encouraged to seek addition information on this broad topic through the other suggested readings. At least one authoritative text on anesthesia should be considered a mandatory addition to the physician's resources.

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2. Miller RD (ed) Anesthesia, 5th edn. Churchill Livingstone, Philadelphia, PA
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Tumescent Anesthesia for Abdominal Liposuction 3

Timothy D. Parish

3.1 Introduction

Tumescent anesthesia may be defined as a subcutaneous, periadipose, hyperhydrostatic pressurized, megadosed, ultra-dilute, epinephrinized, local anesthetic field block [1]. The procedure was first popularized by the dermatologic surgeon Jeffrey Klein in the late 1980s [2, 3]. The majority of the literature revolves around the use of lidocaine as the local anesthetic, although bupivacaine, ropivacaine, and prilocaine have also been utilized [4–9]. Tumescent anesthesia utilizing lidocaine will be the basis of this review.

3.2 Pharmacokinetics

Currently, two standards of care for the safe dosage of lidocaine should now be utilized [10, 11]. First, for commercially available formulations (0.5–2% lidocaine with epinephrine) a 7 mg/kg maximum safe dosage limit. Second, for tumescent anesthesia using ultra-dilute lidocaine 500–1,500 mg/l (0.05–0.15%) with epinephrine (0.5–1.5 mg/l) [12–14]. The diluent is normal saline with the addition of 10–15 mEq sodium bicarbonate per liter. Lactated Ringer's solution may be used and has been documented to prolong the stability of epinephrine secondary to a more acidic pH of 6.3 [13]. A dose of 35 mg/kg of lidocaine can be considered the optimal therapeutic threshold with dosages up to 55 mg/kg approaching the margins of the safe therapeutic window [14–16]. These latter dosage recommendations are based on the clinical experience of large numbers of physicians performing this procedure on a large patient population, together with studies utilizing supplementary anesthetic techniques, including oral (PO), intravenous (IV), and general anesthesia in a total of 163 patients [3, 7, 9, 13, 14, 16, 18–24].

Traditional lidocaine pharmacokinetics utilizing commercial preparations by IV, subcostal, epidural, etc., administration follows the two-compartment model. However, with subcutaneous injection, there is a slower rate of absorption and lower peak serum CMAX compared with equal doses used at other sites of administration [15–24]. The two-compartment model is biphasic and follows the rapid attainment of CMAX in the highly vascular central compartment preceding an accelerated distribution phase until equilibrium with less vascular peripheral tissue is reached. From the point of equilibrium, there is a slow plasma decline secondary to metabolism and excretion [16]. Less than 5% of lidocaine is excreted by the kidneys. In the healthy state, lidocaine clearance approximates plasma flow to the liver equal to 10 ml/kg/min. Lidocaine has a hepatic extraction ratio of 0.7 (i.e., 70% of lidocaine entering the liver is metabolized and 30% remains unchanged). If there is a 50% reduction in the rate of lidocaine metabolism, there will be a corresponding doubling of the CMAX plasma lidocaine [17].

Tumescent anesthesia, with highly diluted lidocaine with epinephrine, exhibits the properties of a one-compartment pharmacokinetic model similar to a slow-release tablet. In a one-compartment model, the body is imagined as a single homogeneous compartment in which drug distribution after delivery is presumed to be instantaneous, so that no concentration gradients exist within the compartment, resulting in decreased concentration solely by elimination of the drug from the system. The rate of change of concentration is proportional to the concentration. This is an essential premise of a first-order process. In a one-compartment model, the location of the drug pool for systemic release is kinetically insulated from the central compartment [18].

The reason that tumescent anesthesia behaves as a one-compartment model is related to the delayed absorption rate into the plasma from the subcutaneous adipose tissue [37]. This is theorized to occur for a number of reasons (Figs. 3.1–3.3): (1) decreased blood flow related to vasoconstriction or vessel collapse proportional to increasing interstitial hydrostatic pressure; (2) formation of an ultra-dilute interstitial lake with a low concentration gradient relative to plasma and increased diffusion distance from the microcirculation; and (3) the high lipophilic nature of lidocaine leads to subcutaneous adipose tissue absorption, acting for a 1,000 mg/l lidocaine formulation (0.1%), as a

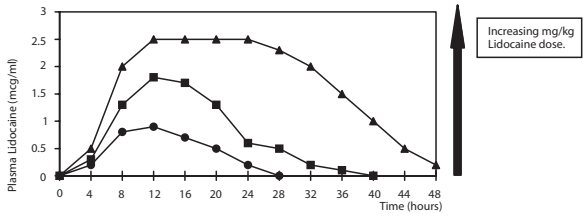

Fig. 3.1. Pharmacokinetics of tumescent liposuction. (Modified from Klein [49]. Reprinted with permission of Mosby Inc.)

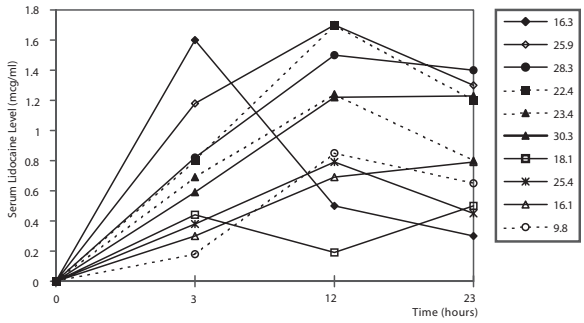

Fig. 3.2. Serum lidocaine levels in patients undergoing tumescent liposuction alone. Total dosage of lidocaine (mg/kg) is listed *to the right*. The patient with the peak lidocaine level at 3 h received 50 mg lidocaine IV. (From Burk et al. [50]. Reprinted with permission of Lippincott, Williams & Wilkins)

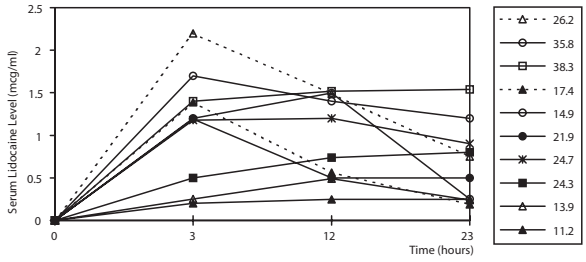

Fig. 3.3. Serum lidocaine levels in patients undergoing tumescent liposuction combined with other aesthetic surgery. Total dosage of lidocaine (mg/kg) is listed *to the right*. (From Burk et al. [50]. Reprinted with permission of Lippincott, Williams & Wilkins)

large 1 mg of lidocaine to 1,000 mg of adipose tissue buffer [10, 19]. This buffering effect is aided by the threefold greater partition coefficient of adipose tissue compared to muscle, enabling lidocaine to bind tightly to fat [20].

At equilibrium, the fat-blood concentration ratio of lidocaine is between 1:1 and 2:1. With increased dosing of lidocaine from 15 mg/kg, there is a well-defined peak CMAX that occurs 4 – 14 h after infiltration. With doses up to 60 mg/kg there is progressive flattening of the peak and a plateau effect that may persist for up to 16 h [21]. The flattening of the curve denotes saturation of the system and then elimination of a constant amount, as opposed to a fraction of the drug per unit time, which signifies zero-order elimination. Although lidocaine levels appear to be below serum concentrations associated with toxicity, it is known that concentrations of 4 – 6 μg/ml have been found in deaths caused by lidocaine toxicity [22, 23]. However, there is no documented data concerning lidocaine stability in postmortem blood and tissues and none related to the fate or physiologic impact of the active metabolites of lidocaine, lidocaine monoethylglycinexylidide, or glycinexylidide [24]. At the same time, because of the slow-release phenomena, toxicity will be present for longer with increased dosing on a milligram per kilogram basis of lidocaine. It is this slow-release process that makes the use of longer-acting local anesthetics irrelevant [13, 14, 25, 26]. According to Klein, liposuction reduces the bioavailability of lidocaine by 20 % [14, 40]. This is further facilitated by open drainage from wounds.

It is the non-protein-bound portion of lidocaine that exhibits toxicity. With increasing total plasma lidocaine levels, there is an increasing proportion of unbound to bound plasma lidocaine as the α1-acid glycoprotein buffer becomes saturated. In the therapeutic range of 1 – 4 μg/ml of lidocaine, up to 40 % of lidocaine is unbound. Surgery and smoking increase serum α1-acid glycoprotein, and oral hormones decrease it. Therefore, increased serum levels of α1-acid glycoprotein result in increased lidocaine binding, decreased free lidocaine, and a buffering of potentially toxic manifestations (Fig. 3.4) [27 – 29, 36, 40].

In a study of 18 patients by Butterwick et al. [20] (Fig. 3.5) using 0.05 – 0.1 % lidocaine with 0.65 – 0.75 mg/l of epinephrine at infusion rates of 27 – 200 mg/min over 5 min to 2 h using dosages between 7.4 and 57.7 mg/kg, there was no correlation between the maximum dose of

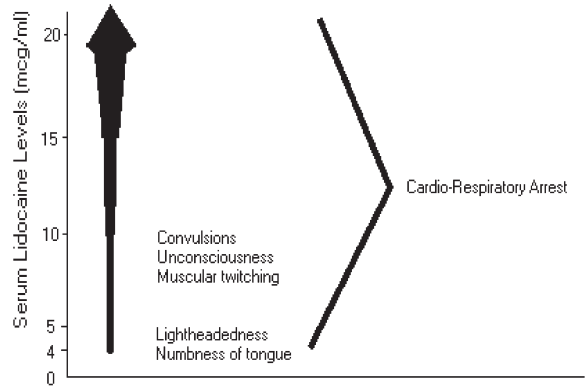

Fig. 3.4. Continuum of toxic effects produced by increasing lidocaine plasma concentrations. (Modified from Barash PG et al. [51]. Reprinted with permission of Lippincott, Williams, & Wilkins)

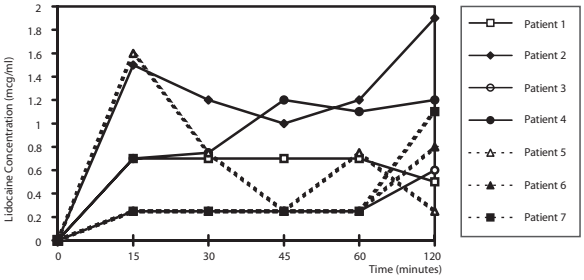

Fig. 3.5. Lidocaine levels over 2 h. (From Butterwick et al. [52]. Reprinted with permission of Blackwell Science, Inc.)

lidocaine (mg/kg) or the rate of lidocaine delivered (mg/ml) with plasma levels of lidocaine. Increased rates of infiltration are associated with increased pain and need for increased sedation [28].

The pharmacokinetics of epinephrine (0.5 – 1 mg/l) are felt to mimic the one-compartment model of the lidocaine. In one study on 20 patients by Burk et al. [19] (Figs. 3.6, 3.7) using epinephrine doses up to 5 mg, the CMAX of 5 times the upper normal limit of epinephrine was reached at 3 h, returning to normal at 12 h.

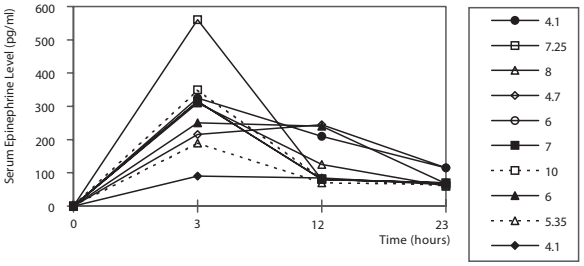

Fig. 3.6. Serum epinephrine levels in patients undergoing tumescent liposuction alone. The total dose of epinephrine (mg) is listed in the figure legend *at right*. (From Burk et al. [50]. Reprinted with permission of Lippincott, Williams & Wilkins)

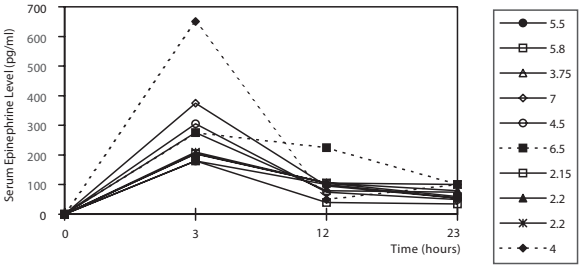

Fig. 3.7. Serum epinephrine levels in patients undergoing tumescent liposuction combined with other aesthetic surgery. The total dose of epinephrine (mg) is listed in the figure legend *at right*. (From Burk et al. [50]. Reprinted with permission of Lippincott, Williams & Wilkins)

3.3 Important Caveats

3.3.1 Drug Interactions

All enzyme systems have the possibility of saturation [29, 30], and once the subcutaneous adipose tissue reservoir is saturated, any free drug has the potential to be absorbed rapidly following the two-compartment pharmacokinetic model with an accelerated rise and decline in the blood lidocaine level; therefore, the prudent favor the currently held safest therapeutic margins and do not stray to the boundaries [10, 31]. All patients taking drugs interfering with the CYP3A4 system should optimally have these medications withheld before surgery. The time of preoperative withdrawal depends upon each drug's kinetic elimination profile [32 – 34] (Table 3.1). The withholding of some of these medications for more than 2 weeks may be the optimal plan. Patients should, therefore, have relevant medical clearance for such an action, according to the basic standards of preanesthetic care (Table 3.2) [35]. Klein suggests that if it is not feasible to discontinue a medication that is metabolized by the cytochrome P450 system, then the total dosage of lidocaine should be decreased. It is not clear how much the dose should be reduced. In the case of thyroid dysfunction, the patient should be euthyroid at the time of surgery. This is an anesthetic truism.

In the author's opinion, all patients should have complete preoperative liver function studies, as well as a screen for hepatitis A, B, and C. However, the free fractions of basic drugs, such as lidocaine, are not increased in patients with acute viral hepatitis; this implies that drug binding to α1-acid glycoprotein is minimally affected in patients with liver disease [35]. The physician should also inquire about over-the-counter herbal remedies and recommend withholding those for 2 weeks before surgery. The cocaine addict's surgery should be canceled, and the nasal-adrenergic addict should be guided into withdrawal from this medication.

All systemic anesthetics, particularly general anesthesia, have the potential to decrease hepatic blood flow. However, general anesthesia has the greatest potential, although the potpourri approach probably increases this likelihood. General anesthesia decreases hepatic blood flow, resulting in decreased lidocaine metabolism. Inhalational anesthetics, hypoxia, and hypercarbia are potentially arrhythmagenic, and the interface of this with mega doses of ultra-dilute epinephrine perhaps increases this potential. The counterbalance of the increased dose of lidocaine is poorly understood, and in animal studies lidocaine toxicity may present as marked hypotension and bradycardia in lethal doses that occurs without arrhythmias [36]. The ideal

Drug	Plasma half-life
Acebutolol	Biphasic: α phase 3 h, β phase 11 h
Amiodarone (Cordarone)	Biphasic: α phase 2.5 – 10 days, β phase 26 – 107 days (average 53 days)
Atenolol	7 h
Carbamazepine (Tegretol, Atretol)	25 – 65 h
Cimetidine (Tagamet)	2 h
Chloramphenicol (Chloromycetin)	68 – 99 % excretion in 72 h
Clarithromycin (Biaxin)	3 – 7 h
Cyclosporin (Neoral, Sandimmune)	10 – 27 h (average 19 h)
Danazol (Danocrine)	4 – 5 h
Dexamethasone (Decadron)	1.8 – 2.2 h
Diltiazam (Cardizem)	3 – 4.5 h
Erythromycin	1 – 3 h
Esmolol (Brevibloc)	Biphasic: α phase 2 min, β phase 5 – 23 min (average 9 min)
Flucanazole (Diflucan)	20 – 50 h
Fluoxetine (Prozac)	1 – 3 days after acute administration, 4 – 6 days after chronic administration
Norfluoxetine (active metabolite)	4 – 16 days
Flurazepam (Dalmane)	47 – 100 h
Isoniazid (Nydrazid, Rifamate, Rifater)	Excreted within 24 h
Itracanazole (Sporanox)	24 h after single dose, 64 h at steady state
Ketoconazole (Nizoral)	Biphasic: α phase 2 h, β phase 8 h
Labetalol (Normodyne, Trandate)	6 – 8 h
Methadone (Dolophine)	25.0 h
Methylprednisolone (Medrol)	2 – 3 h
Metoprolol (Lopressor)	3 – 7 h
Metronidazole (Flagyl)	6 – 14 h (average 8 h)
Miconazole (Monistat)	IV 24 h
Midazolam (Versed)	Biphasic; α phase 6 – 20 min, β phase 1 – 4 h
Nadolol (Corgard, Corzide)	10 – 24 h
Nefazodone (Serzone)	1.9 – 5.3 h, active metabolite 4 – 9 h
Nicardipine (Cardene)	Average 8.6 h
Nifedipine (Procardia, Adalat)	2 h (extended release in 6 – 17 h, average 8 h)
Paroxetine (Paxil)	17 – 22 h
Pentoxifylline (Trental)	1 – 1.6 h
Pindolol (Visken)	3 – 4 h
Propranolol (Inderal)	4 h
Propofol (Diprivan)	1 – 3 days
Quinidine	6 – 12 h
Sertraline (Zoloft)	Average 26 h, active metabolite 62 – 104 h
Tetracycline	6 – 12 h
Terfenadine (Seldane)	Mean 6 h
Thyroxine (levothyoxine)	5 – 9 days
Timolol (Timolide, Timoptic)	3 – 4 h
Triazolam (Halcion)	1.5 – 5.5 h
Valporic acid (Depakene)	6 – 16 h
Verapamil (Calan, Isoptin, Verelan)	4 – 12 h
Zileuton (Zyflo)	2.1 – 2.5 h

Table 3.1. Drugs which inhibit cytochrome P450. (Modified from Shiffman [34], McEvory [53], and Gelman et al. [54])

Table 3.2. Basic standard for preanesthesia care. (Modified from *ASA Standards, Guidelines, and Statement.* American Society of Anesthesiologists. Available at: http://www.ASAhg.org. Accessed October 1999)

The development of an appropriate plan of anesthesia care is based on:
1. Reviewing the medical record.
2. Interviewing and examining the patient to:
   a) Discuss the medical history, previous anesthetic experiences, and drug therapy
   b) Assess those aspects of the physical condition that might affect decisions regarding perioperative risk and management
3. Obtaining or reviewing tests and consultations necessary to the conduct of anesthesia
4. Determining the appropriate prescription of preoperative medications as necessary to the conduct of anesthesia

preoperative anesthetic, says Klein, is clonidine 0.1 mg (PO) and lorazepam 1 mg (PO). These can be taken 1 h before surgery, although lorazepam can be taken the night before surgery. This preoperative regimen is administered to patients who have a blood pressure greater than 105/60 mm Hg and a pulse greater than 70 beats/min. Lorazepam does not interfere with the CYP3A4 hepatic enzyme system [37].

3.3.1.1 Volume of Distribution

Thin patients have a smaller volume of distribution, and therefore, potentially, a greater CMAX than an obese patient, given an identical dosage of lidocaine

[38, 39]. Similarly, men have a smaller volume of distribution for lidocaine, secondary to increased lean body mass. In these two situations, the maximum allowable dose should be decreased by up to 20% with a maximum dosage of 45 mg/kg being a reasonable upper limit. Older patients have a relative decrease in cardiac output leading to decrease in hepatic perfusion, and therefore maximum safe dosages should be decreased approximately 20%. This 20% decrease has a greater margin of safety if applied to a 35 mg/kg maximum safe dosage of lidocaine than it does if applied to a 50 mg/kg maximum safe dosage of lidocaine.

3.3.1.2 Classifications of Patients

As an elective outpatient procedure, ideally only ASA I and II patients, should be selected. Morbid obesity may be classified as an ASA III-type patient and significantly increases the risk of any form of anesthetic.

3.3.1.3 Two Sequential Procedures are Better than One

The risk of perioperative morbidity and mortality increases with increasing time of the procedure and size of the procedure. This includes separate procedures performed under the same anesthetic. This is an anesthetic truism. The AACS *2000 Guidelines for Liposuction Surgery* state that the maximal volume extracted may rise to 5,000 ml of supernatant fat in the ideal patient with no comorbidities. The guidelines also state that the recommended volumes aspirated should be modified by the number of body areas operated on, the percentage of body surface area operated on, and the percentage of body weight removed. Currently held conservative guidelines limit the total volume of supernatant fat aspirate to less than or equal to 4 l in liposuction cases [40, 41]. The more fat removed, the greater the risk for injury and potential complications.

3.3.1.4 Intravenous Fluids

Tumescent anesthesia significantly decreases blood loss associated with liposuction [13, 42, 43]. Studies have shown that between 10 and 70 ml of blood per liter of aspirate is lost depending on the adequacy and rate of tumescent infiltration [44–48]. Tissue tumescence is obtained by doubling the volume of subcutaneous adipose tissue in the area to be addressed. On average, the ideal ratio of tumescent anesthesia to aspirated fat is 2:1 to 3:1 [45].

Tumescent crystalloid infiltration follows the one-compartment kinetic model [45]. Without IV infusion, approximately 5 l of normal saline tumescence results in hemodilution of the hematocrit by approximately 10%, no change in the urine specific gravity, and maintenance of urine output greater than 70 ml/h [46]. According to Klein, if the extraction of supernatant fat is less than 4 l (representing 3–4% of total body weight), then there is no clinically detectable third-spacing injury and intravascular fluid administration is not required. Fluid overload remains as a potentially significant perioperative mishap [47–49], and therefore bladder catheterization with larger cases should be considered [10].

3.3.2 Anesthetic Infiltration

The author's preferred technique is to utilize multiple entry points via 1.5–2.0 mm punch biopsy sites, starting with deep infiltration then working superficially until tumescence is obtained. Particular attention is paid to the periumbilical area as this area has increased sensitivity and fibrous tissue. Following tumescence, it is advisable to allow for detumescence over a 20–30 min waiting period prior to beginning liposuction. Care must be taken preoperatively to identify any evidence of abdominal hernias or rectus diasthesis. In-office abdominal ultrasound nicely complements the clinical exam. The shorter the infiltration cannula, the greater the control, and the smaller diameter of the cannula, the less the pain (Table 3.3).

3.3.3 Allergic Reactions

Case reports of allergic reactions to amide local anesthetics have been documented. Methylparaben, a preservative agent found in amide local anesthetic preparations, is metabolized to PABA, which is a highly antigenic substance. In addition, allergic reactions are rare-

Table 3.3. Recommended concentrations for effective tumescent anesthesia utilizing normal saline as the diluent. (Modified from Klein [55, 56])

Concentration Areas	Lidocaine (mg/l)	Epinephrine (mg/l)	Sodium bicarbonate (mEq/l)	Approximate volume[a] Small patient (ml)	Large patient (ml)
Female abdomen	1,000–1,250	1.0	10	800–1,400	2,000–2,800
Male abdomen	1,000–1,250	1.0	10		
Basic/checking	500	0.5	10		

[a] Note: dose utilized should be calculated on mg/kg basis

ly caused by antioxidants that are found in local anesthetics, such as sodium bisulfite and metabisulfite. Hypersensitivity reactions to preservative-free formulations of amide local anesthetics are rare, but also have been reported.

Conclusion

Tumescent anesthesia for abdominal liposuction is an effective and safe anesthestic providing the above guidelines are followed.

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4 Abdominoplasty History and Techniques

Sid Mirrafati

4.1 Introduction

Numerous papers and articles have been written about the different techniques of the abdominoplasty procedure and date back from over a century ago. Body sculpting and contouring has been a fascination of many cosmetic surgeons. With the advent and popularity of the liposuction procedure these days and with a better understanding of skin retraction postliposuction surgery, many of the previously treated abdominoplasty procedures are now treated by the less invasive and more rapid recovery procedure of liposuction surgery. Nevertheless, abdominoplasty still holds a very intricate and self-satisfying place in the world of cosmetic surgery. Abdominoplasty not only deals with the excess abdominal pannus but also corrects diastasis of the rectus muscle and sometimes the external oblique muscle as well. It is a more invasive and a more complete surgery and therefore it also carries a higher morbidity and mortality. It is a procedure that also requires sculpting ability and the knowledge to place the incision to suit the particular body type.

4.2 History and Techniques

Throughout the past century there have been many surgeons who have described different abdominoplasty procedures to achieve better sculpting or to hide the abdominal scar. Body contouring dates back to 1870, which was the beginning of the modern surgical era. This was limited to a small resection of the abdominal wall. The surgeons who were repairing massive umbilical hernias did the first dermolipectomy of the abdomen. Excision of the abdominal pannus facilitated the hernia repair and relieved the patient from the hanging pannus.

In 1890 Demars and Marx [1] reported the first limited dermolipectomy in France. Kelly [2], a gynecologic surgeon, was the first to report this procedure in the United States at John Hopkins Hospital in Baltimore in 1899. Kelly called the procedure "transverse abdominal lipectomy". He performed herniorrhaphy through a transverse incision extending across both flanks. The hanging abdominal pannus was resected and the incision closed without undermining; however, this resulted in sacrificing the umbilicus (Fig. 4.1).

After this there were many more reported cases in Europe especially in France. In 1905, Gaudet and Morestin [3] reported on a transverse incision of the abdomen in repairing large hernias along with the resection of the excess abdominal skin and fat and were the first to report preservation of the umbilicus. In 1909 Weinhold [4] from Germany reported the cloverleaf incision, which is the combination of vertical and oblique incisions (Fig. 4.2), to improve the contour of the abdominal wall. In 1911, Desjardin [5] reported the excision of excess skin and fat weighing over 22.4 kg through an elliptical vertical abdominal incision. In the same year Amedee Morestin [6], the younger brother of the Hippolyte Morestin, reported five cases of massive

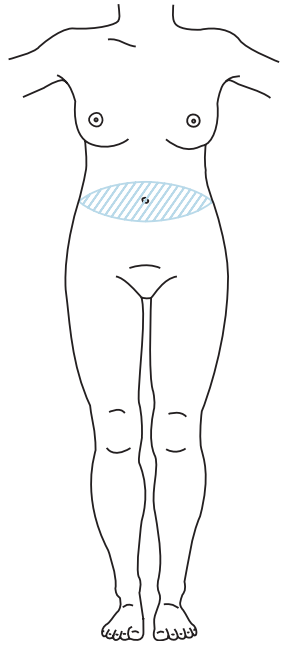

Fig. 4.1. Kelly (1899) [2]

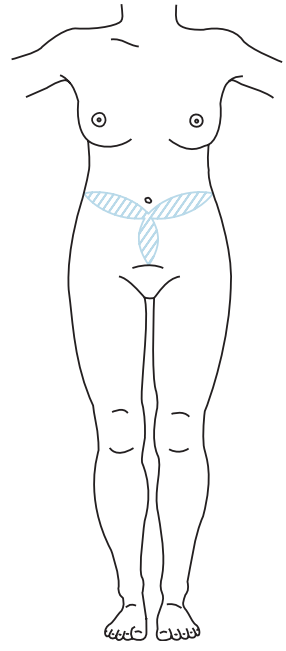

Fig. 4.2. Weinhold (1909) [4]

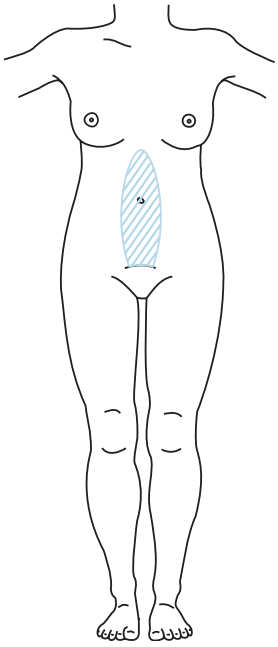

Fig. 4.3. Babcock (1916) [8]

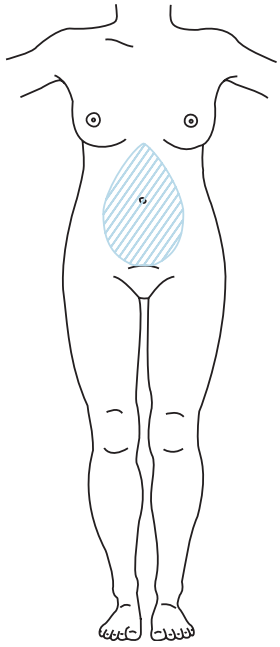

Fig. 4.4. Schepelmann (1918) [9]

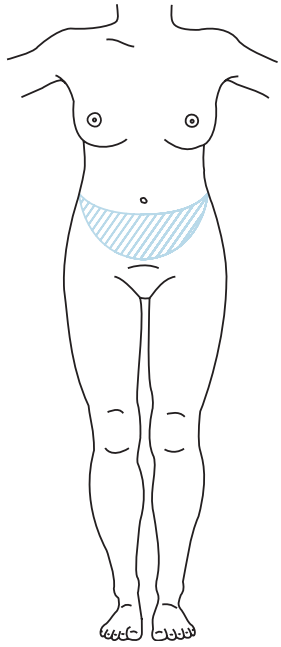

Fig. 4.5. Thorek (1924) [10]

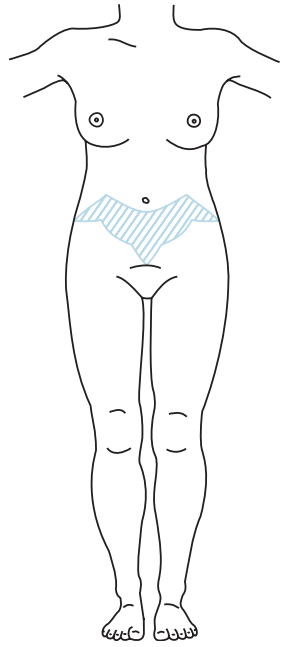

Fig. 4.6. Pick (1949) [13], Barsky (1950) [14]

abdominal lipectomy through an elliptical transverse incision similar to that reported by Kelly. Jolly, in 1911 [7], reported a low transverse elliptical abdominal lipectomy.

In 1916, Babcock [8] was the first to report vertical elliptical resection with wide undermining of the abdominal wall. He described a vertical elliptical incision the length of the abdomen (Fig. 4.3). He also dealt with the abdominal wall laxity with the buried silver chain technique. In 1918, Schepelmann [9] modified the Babcock elliptical incision into a transverse teardrop incision extending from the xyphoid to the pubis (Fig. 4.4). This allowed for more contouring of the lower abdominal excess.

In 1924, Thorek [10] started the technique of placing the incision below the umbilicus in a transverse fashion and removed the excess skin and fat down to the fascia in a wedge shaped form. He called the technique plastic adipectomy (Fig. 4.5). He described the removal of the umbilicus if required in a crescent excision, and transplanting it to its new place at the end of the case as a composite graft. In 1931, Flesch-Thebesius and Wheisheimer [11] modified the Thorek incision and included the umbilicus. In 1939, Thorek [12] reported his technique of plastic adipectomy. In 1949 Pick [13] reported his technique, followed by Barsky in 1950 [14], which was a modification of the Thorek transverse incision with the addition of the vertical incision at the ends (Fig. 4.6).

In 1955, Galtier [15] reported his technique of resection in four quadrants (Fig. 4.7). Vernon in 1957 [16] reported his technique of low transverse incision with wide undermining and transposition of the umbilicus (Fig. 4.8). This was followed by Dufourmental and Mouly in 1959 [17], who included the Vernon technique with the addition of a small vertical incision at the center (Fig. 4.9).

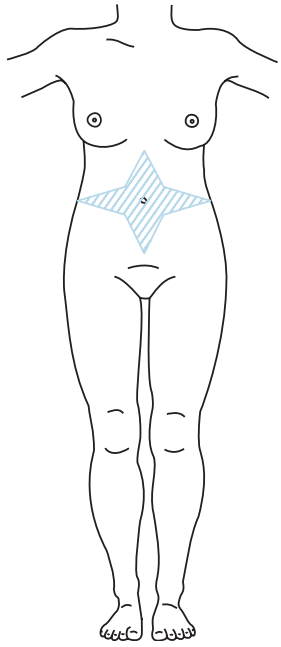

Fig. 4.7. Galtier (1955) [15]

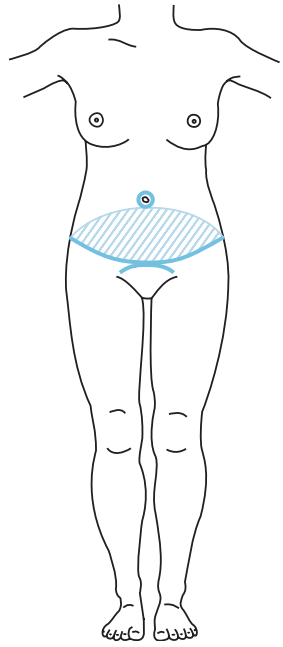

Fig. 4.8. Vernon (1957) [16]

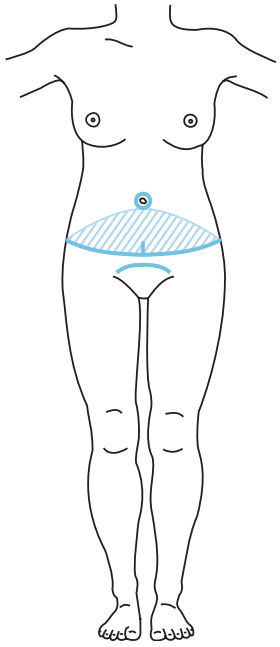

Fig. 4.9. Dufourmental and Mouly (1959) [17]

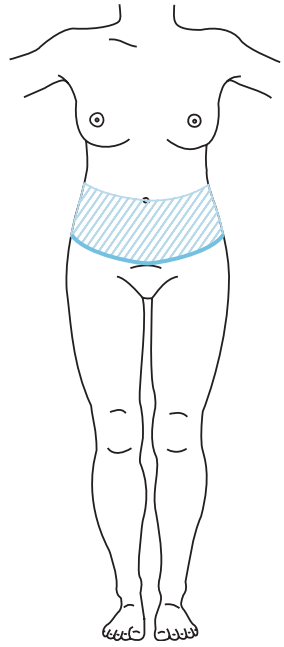

Fig. 4.10. Gonzalez-Ulloa (1960) [18], Vilain (1964) [19]

Gonzalez-Ulloa in 1960 [18] and Vilain and Dubouset in 1964 [19] reported circular abdominoplasty similar to that of Pick and Barsky (Fig. 4.6). In 1965 Spadafora [20] reported a similar technique to Vernon's, but he lowered the incision to a less conspicuous site. His incision started at the center, curving around the mons pubis, and at the groin crease the incision curved upward toward the anterior superior iliac spine. In 1967, Callia [21] reported a similar incision to Spadafora's except the incision was placed below the inguinal crease (Fig. 4.10). Staying below the inguinal crease not only had a less conspicuous scar but also had the added advantage of some degree of lateral thigh lift.

In reviewing the literature up to 1967, the abdominoplasty procedure can be divided into three main categories: (1) surgeons that favored the transverse incision, (2) those that favored the vertical incision (3) and the remainder that reported a combination of vertical and transverse incisions (Fig. 4.11). After 1967 there were many modifications of Callia's technique, but surgeons started favoring the low transverse, inconspicuous scarring.

In 1967 Pitanguy [22] published his technique, which was considered to produce successful results. From 1967 to 1975 he reported more than 500 cases of abdominoplasty and mammaplasty at the same time [23]. Pitanguy not only favored a low transverse abdominal and groin incision but also advocated extensive undermining over the costal margins, muscle tightening, and compression dressing (Fig. 4.12).

In 1972 Regnault [24] reported the "W" technique incision, which she later modified in 1975. The incision started from 1–3 cm within the pubic hair line and curved around the mons pubis to the groin crease and then extended laterally upward (Fig. 4.13). This technique minimizes the long-term superior pull of the mons pubis and unsightly suprapubic scaring. Grazer,

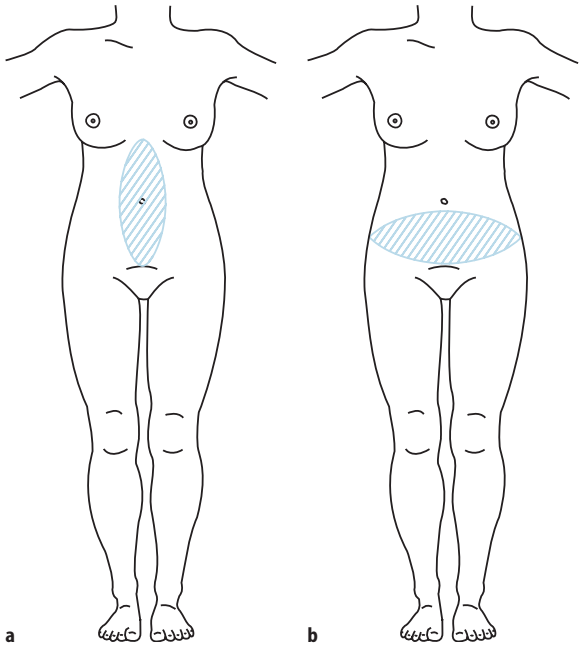

Fig. 4.11. a Transverse incision; **b** vertical incision; **c** combined incisions

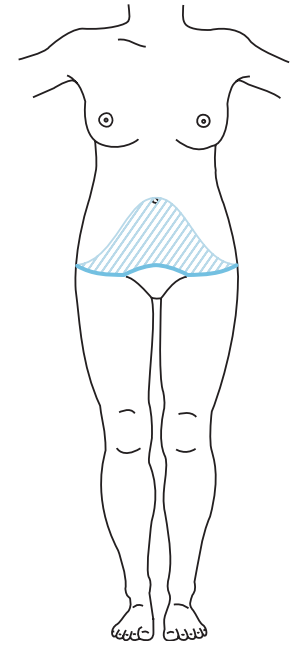

Fig. 4.12. Pitanguy (1967) [22]

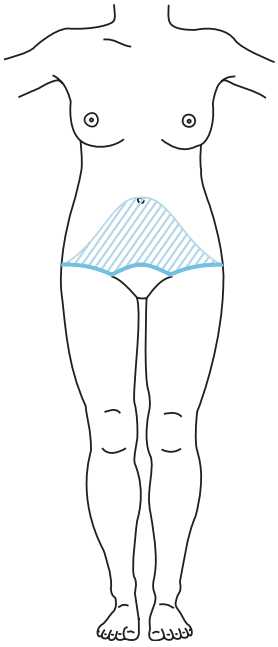

Fig. 4.13. Regnault (1972) [24]

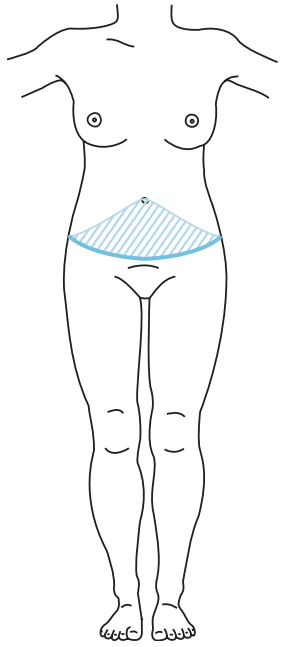

Fig. 4.14. Grazer (1973) [25]

in 1973 [25], reported 44 cases of abdominoplasty and mostly combining other surgeries as well. Grazer advocated a low transverse incision along the skin crease and extended laterally up to the level of the old umbilicus along the bikini line (Fig. 4.14). In 1977, Baker, Gordon, and Mosienko [26] reported the template method of abdominoplasty.

In 1978, Planas [27] advocated the "vest over pants" technique. This technique starts the incision from the umbilicus and extends diagonally down to the lateral extension of the low transverse incision. The upper abdomen is then undermined and pulled down over the lower abdomen and the incision is tailored and closed like a vest over pants. For individuals with extensive abdominal and flank pannus the surgery of belt lipectomy, which is a transverse incision extending to the back around the waist in a belt-like fashion, was first introduced by Somalo in 1940 [28] and later popularized by Gonzalez-Ulloa in 1959 [29].

The belt lipectomy was superseded by suction assisted lipectomy (liposuction) and abdominoplasty in 1980 that was popularized by Illouz [30] in 1983. The use of liposuctioning and abdominoplasty has revolutionized the concept of body contouring. Abdominoplasty will serve to repair the underlying muscles, which are plicated, and liposuction will contour the overlying fat, but attention must be given to the danger zone and the safe zone when doing a liposuction.

With the advent of suction-assisted lipectomy in 1975, there was also a rebirth of mini-abdominoplasty. Prior to this time mini-abdominoplasty was of limited use because it only provided corrections for a small amount of lower abdominal skin and fat. Mini-abdominoplasty was first introduced by Elbaz and Flageul in 1971 [31] and was modified by Glicenstein in 1975 [32]. After the introduction of suction-assisted lipectomy, Wilkinson and Swartz [33] reported 35 patients with mini-abdominoplasty in 1986 and in 1987 Greminger [34] reported a series of 14 patients.

The history of full abdominoplasty and mini-abdominoplasty has taken many different routes, but these techniques have certainly evolved to be an integral part of cosmetic surgery and body contouring, and there are still more developments on the way with newer techniques that have less blood loss and faster recovery.

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Patient Consultation and Instructions for Abdominoplasty

5

Melvin A. Shiffman

5.1 History

The patient must have a sufficient history taken to establish the problem of which the patient complains. Past history, review of systems, and family history should include all information that may impact on the proposed surgical procedure and its outcome such as prior abdominal surgeries. There must be an attempt to rule out cardiac or pulmonary problems, allergies, bleeding problems, diabetes mellitus, medications being taken such as aspirin, ibuprofen, herbals, antihypertensives, anticoagulants, and estrogens. Prior thrombophlebitis or pulmonary embolus is important to elicit. Family history should include questions about bleeding tendencies or thromboembolism.

5.2 Physical

The physical examination should not be cursory. The systems examined should include the heart and lungs as well as the area(s) of the body involved in the patient's complaint(s). There should be a careful evaluation for possible abdominal wall or umbilical hernias. The medical record should contain all of the appropriate information for another physician, who may examine the record, to come to the same conclusions and decisions as the operating surgeon. Preoperative and postoperative photos are essential.

5.3 Medical Record

The content of the medical record should be sufficient to show that an informed consent has been given through explanation of the proposed procedure, possible viable alternatives, and the risks and complications. This does not mean only forms signed by the patient containing the information. The patient must make a knowledgeable decision about the proposed procedure and the physician should take an active part in making sure this is achieved even if some other healthcare provider has explained the procedure and risks.

The physical must be recorded with enough pertinent information that would allow another physician to come to the same conclusions as to the diagnosis and the treatment. This includes pertinent negative findings.

The record should contain the recommendations and the reasons for the recommended procedure or treatment. The physician's thinking is an important aspect of the medical record and will substantiate any proposed or advised therapy.

5.4 Consent

To obtain *consent* for a surgical procedure all that is necessary is for the patient to sign a consent form stating what the procedure is in lay terms. To obtain a legally valid *informed consent* requires much more. The patient should not only know the name of the procedure in lay terms but also what is being done in the procedure in simple language. The *material risks* and complications must be explained to the patient as well as any *viable alternatives* of treatment and their material risks and complications. The patient must make a *knowledgeable* decision concerning the surgery.

Preoperative and postoperative instructions probably should be made available not only in writing but by oral instruction as well. The patient should be made aware as to what to expect after surgery.

5.5 Explanation of Abdominoplasty (Abdominal Lift)

Abdominoplasty (abdominal lift) is a procedure to remove excess fat and skin from the lower abdomen by lifting the skin and fat off the underlying muscles from the pubis to the ribs, tightening the underlying muscles, and tightening the skin by removal of the excess. Drainage tubes (one on each side) are left in place after surgery for approximately 3 days or until the drainage

from the tubes has significantly decreased (usually no more than 50 ml from each tube over a 24-h period of time). The operation gives a flatter appearance to the abdomen, but leaves a scar around the umbilicus and across the lower abdomen.

5.6 Risks and Complications of Abdominoplasty

Explaining the possible risks and complications to the patient may be done by the office staff or through the use of an audiovisual recording. The physician has to be involved in the discussion in order to establish rapport with the patient and to be available to answer questions.

If scars are present from prior abdominal surgical procedures, those in the lower abdominal wall will usually be completely resected with the abdominoplasty. If there are upper abdominal scars, the risk of necrosis of the flap is increased and variations on the usual abdominoplasty incision may be necessary. If the skin cannot be totally resected from above the umbilicus down to the lower abdominal incision, there may be a vertical scar from the umbilicus to the transverse lower abdominal scar.

A list of complications with the patient's initialing each paragraph, by itself, is not adequate in and of itself. Someone must discuss these with the patient to make sure that each risk is understood.

1. Bleeding, hematoma, bruising
2. Seroma (fluid collection), chronic pseudocyst
3. Infection, sepsis
4. Sensory loss
5. Skin necrosis with delayed healing (weeks to months)
6. Dehiscence (wide opening of wound) with prolonged period of healing (weeks to months)
7. Scarring: wide, hypertrophic, or keloid
8. Asymmetry
9. Persistent edema (swelling)
10. Umbilicus off center or loss of umbilicus
11. Dog ears
12. Need for further surgery
13. Thromboembolic disorder, fat emboli
14. Anesthesia risks, i.e., drug reactions, cardiac arrhythmias, pulmonary problems

5.7 Alternatives to Abdominoplasty

5.7.1 Liposuction

Liposuction alone or in combination (before, during, or after) with abdominoplasty should be discussed if any of these appear to be a viable alternative. The risks and expected results must be explained as well as the reasons for preferring abdominoplasty alone.

5.7.2 Limited Abdominoplasty

If there is loose skin mainly in the lower abdomen but not enough to remove skin from the pubis to the umbilicus, alternatives include a limited resection in the lower abdomen without moving the umbilicus or a more aggressive resection leaving a vertical midline lower abdominal scar (Fig. 5.1). The limitations as well as the advantages of each procedure should be discussed if there appear to be viable alternatives.

Fig. 5.1. More extensive minimized abdominoplasty without enough skin to resect in the lower abdomen to allow a low transverse scar. This results in an acceptable midline and transverse scar if the patient is forewarned prior to surgery

5.8 Preoperative Instructions

A careful history must be taken to include at least prior abdominal surgical procedures, present medication being used, allergies, intake of steroids within the previous 12 months, blood dyscrasia or bruising problems (including family members), smoking, drug or alcohol abuse, or any other problem that might interfere with normal healing or increase anesthesia risk (heart or lung disease).

No aspirin or product containing aspirin is to be taken within 2 weeks prior to and following surgery. This includes prescription medications or over-the-counter products. Vitamins and herbals should be avoided for 2 weeks prior to and 2 weeks after surgery while estrogens (birth control pills or hormone replacement therapy) should be stopped for at least 3 weeks preoperatively and 2 weeks postoperatively. Hormones may be a problem to avoid in certain patients but the increased

risk of thromboembolic disease must be explained. The surgeon may wish to avoid operating at a time when the menstrual period is expected, especially the first 5 days of menstrual bleeding, although I personally have never seen a bleeding problem in an abdominoplasty done during menses.

Many physicians request skin cleansing by showering with Hibiclens or Phisohex for 3 days prior to surgery and in the morning of the day of surgery.

5.9 Postoperative Instructions

Drainage tubes are used following abdominoplasty for approximately 3 days or when the amount of daily drainage has been reduced sufficiently. The patient and/or the family must be made completely familiar with the methods of emptying and reestablishing vacuum in the reservoir. Pain will tend to decrease substantially after the drains are removed.

The patient or caretaker should be instructed to call the doctor if there is bleeding through the dressings, drainage of pus, increasing pain, or other unusual symptoms (shortness of breath, chest pain, mental confusion, etc.)

Prescriptions for pain medication and an antibiotic are given to the patient, making sure there is no allergy to either drug.

Usually, the dressings are not changed for the first 3 days (until such time as the drains are ready to be removed). The patient should be instructed to call the surgeon if there appears to be excessive bleeding into the dressings, increasing pain, drainage of pus, or an unusual foul smell from the wound or dressing.

The patient should be instructed in diet and limitations of activities. The author usually limits the length of time of sitting for 3 weeks postoperatively.

5.10 Conclusions

A properly instructed patient is essential to obtain an informed consent for a surgical procedure. Not only must the contemplated surgical procedure with its material risks and complications be explained, but also any viable alternatives and their material risks. The patient must be informed about preoperative as well as postoperative care. Adequate time should be spent with the patient to make sure that the patient understands all that is said and has the opportunity to have all questions answered. These discussions must be adequately entered into the medical record since the record is the physician's best defense (see Chapter 26).

6 Abdominolipoplasty: Classification and Patient Selection

Steven G. Wallach, Alan Matarasso

6.1 Background

By the late 1970s, abdominoplasty techniques evolved into a standardized procedure involving uniform treatment of the soft tissue layers and moving from combined vertical and horizontal incisions to one form of a low transverse incision. The introduction in the 1980s of suction assisted lipectomy (SAL) added a new dimension to abdominal contour surgery. Liposuction procedures alone or in combination with abdominoplasty allowed more patients with a wider variety of abdominal contour deformities to be successfully treated. From these concepts evolved the abdominolipoplasty classification system, a logical method to define and then treat abdominal contour deformities [1–3]. Further refinement of these techniques occurred in the 1990s when new concepts for minimal access procedures were developed with advances in liposuction and endoscopy [4].

6.2 Patient Diagnosis and Selection

Acquired abdominal contour deformities can be the result of weight gain or fluctuations, aging, pregnancy, hormones, medications, lifestyle, and previous surgical incisions. Surgical correction is recommended for patients concerned about their abdominal contour when diet and exercise do not help.

The goals of surgery include: removing excess loose skin, decreasing the subcutaneous fat content, and tightening the underlying musculofascial system employing the least conspicuous incision. In discussing abdominal contour corrections with patients, the goals have to be clearly defined. A flatter abdomen is important and this will certainly depend upon the patient's underlying soft tissue and bony architecture. Lower abdominal bulges can result from the tendency for fat accumulation in the lower abdomen as well as from an absence of the posterior rectus sheath below the arcuate line of Douglas (Fig. 6.1). Intraperitoneal fat (visceral adipose tissue) is not treated by any abdominal contour procedure; it accumulates with age and is more likely to be found in men. Women also accumulate this type of fat as they approach menopause. Relaxation of the musculature and restraining ligaments, and skeletal abnormalities such as lumbar lordosis, should also be discussed and pointed out to the patient during the consultation since these conditions preclude achieving a flat contour. All these factors may detract from the overall appearance and successful outcome of abdomi-

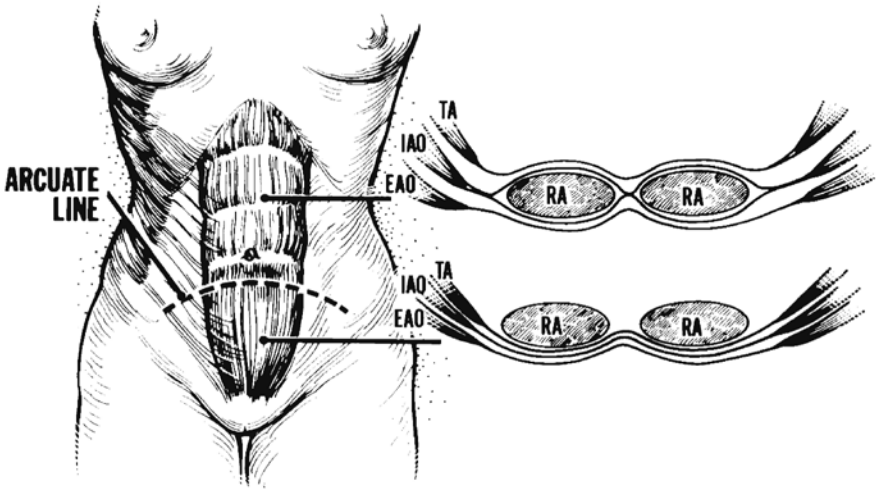


Fig. 6.1. Surgery anatomy of the anterior abdominal wall (*TA*, transversus abdominus; *RA*, rectus abdominus muscle; *IAO*, internal oblique muscle; *EAO*, external oblique aponeurosis) [1]

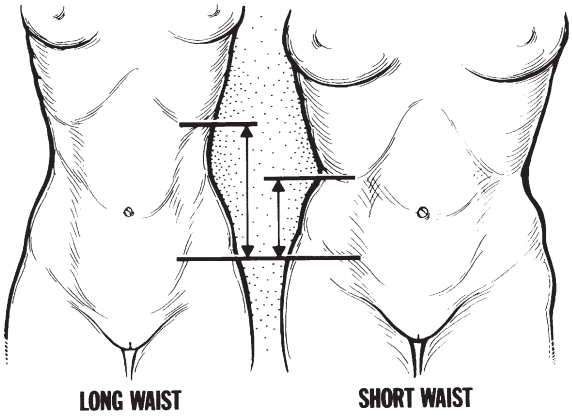


Fig. 6.2. Basic dimensions: short- versus long-waisted abdomen

nal contour surgery. As Greminger [5] has illustrated, the bony structure of the torso and pelvis determines the basic dimensions ("short" or "long" waisted) of the abdomen (Fig. 6.2). This leads to a general impression of the patient's overall body habitus.

Examination of the patient is performed in the standing, sitting, supine, lateral, and lateral hip flexed (diver's) positions to evaluate treatable areas of the skin, subcutaneous fat, and muscle layers. Differences in underlying anatomy including body proportions, bony architecture, umbilical variations, hernias, scars, and treatable soft tissue regions are noted. The skin quality, degree of subcutaneous fat accumulation, and extent of muscular diastasis or weakness are reviewed with the patient in front of a three-way mirror. Finally concerns of the patient regarding the extent of surgery including the tolerance of possible complications, recovery, and incisions all factor into the decision-making process.

After all these issues are considered, patients are then staged according to the abdominolipoplasty system of classification and treatment: Type 1, suction assisted lipectomy; Type 2, mini-abdominoplasty; Type 3, modified abdominoplasty; and Type 4, full abdominoplasty (Table 6.1). With the addition of minimally invasive techniques to the repertoire, subdivisions of the abdominolipoplasty classification system evolved allowing for smaller and fewer incisions. This includes: Type 1a, extended liposuction; Type 2a, open mini-abdominoplasty; and Type 3, endoscopically assisted or muscle access abdominoplasty (Table 6.2).

6.3 Contraindications

Abdominal contour surgery is contraindicated in those patients with unrealistic expectations and those with medical conditions that preclude surgery. Patients who are considering pregnancy in the future might want to consider delaying muscular plication or skin removal procedures [7, 8], although suction lipectomy can be performed. Smoking in general increases surgical risks and should be avoided completely.

6.4 Blood Supply of the Abdominal Wall

When combining abdominoplasty and SAL techniques it is important to have an understanding of the blood supply to the abdomen. Huger [9] evaluated the changes in the abdominal wall blood supply after full abdominoplasty and described three vascular zones. Zone I consists of the midabdomen and is mainly supplied by the deep epigastric arcade. Zone II consists of

Table 6.1. Abdominolipoplasty classification system

Category	Skin	Fat	Musculofascial system	Treatment
Type I	Minimal laxity	Variable	Minimal flaccidity	Suction-assisted lipectomy
Type II	Mild laxity	Variable	Mild lower abdominal flaccidity	Mini-abdominoplasty
Type II	Moderate laxity	Variable	Moderate lower and/or upper abdominal flaccidity	Modified abdominoplasty
Type IV	Severe laxity	Variable	Significant lower and/or upper abdominal flaccidity	Standard abdominoplasty with suction lipectomy

Table 6.2. Minimal access subtypes of the abdominolipoplasty system. Bold items distinguish these subtypes. Access abdominoplasty – abdominoplasty incision as approach to second operation

Category	Skin	Fat	Musculofascial system	Treatment
Type 1a	Minimum laxity	↑↑	Minimum flaccidity	Extended SAL
Type 2a	**Mild laxity (vertical scar)**	V	Mild lower abdominal flaccidity	"Open mini"
Type 3a	Minimum laxity	V	**Lower/upper abdominal flaccidity**	Endoscopic muscle access

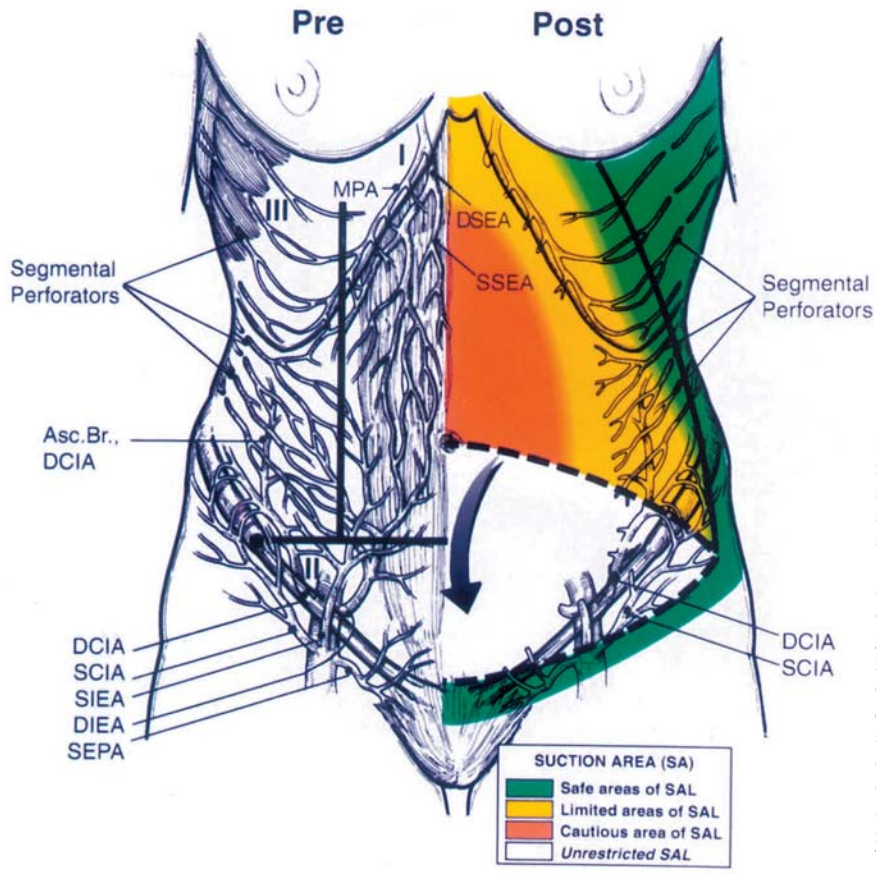


Fig. 6.3. Blood supply to the anterior abdominal wall. Note Huger zones I–III. Vascular anatomy and its relationship to potential areas of suction lipectomy (*DSEA*, deep superior epigastric artery; *SSEA*, superficial superior epigastric artery; *MPA*, marginal phrenic artery; *DIEA*, deep inferior epigastric artery; *DCIA*, deep circumflex iliac artery; *SCIA*, superficial circumflex iliac artery; *SIEA*, superficial inferior epigastric artery; *SEPA*, superficial external pudendal artery; segmental perforators (Zone III), intercostal, subcostal, and lumber arteries) [10]

branches from the external iliac artery providing supply for the lower abdomen, and Zone III, which consists of the flanks and lateral abdomen, is supplied by the intercostal, subcostal, and lumbar arteries (Fig. 6.3).

The four regions most often suctioned are referred to as suction areas 1 – 4 (SA1 – 4) (Fig. 6.4). These areas are based upon the vascular anatomy and safety when combined with a full (type 4) abdominoplasty. Combining SAL with a full abdominoplasty may risk flap viability especially if SAL is performed in SA-3. This area is located in the middle of the undermined flap from the umbilicus to the pubis. The safest zone for suctioning after type 4 abdominoplasty is in SA-1 followed by suctioning in SA-2. SA-4 represents a theoretic area that is suctioned in type 1 – 3 abdominoplasty.

By understanding the vascular changes with abdominoplasty, SAL performed can be tailored so that maximal blood supply can be provided to the tissues and in turn will minimize the risk of complications. For type 1 – 3 abdominoplasty patients, the epigastric cascade in Zone I is preserved and therefore perfusion to the abdominal flap is reliable. Consideration should be given to a full abdominoplasty combined with liposuction because of the extensive undermining of surgery and the partial undermining of SAL. The new domi-

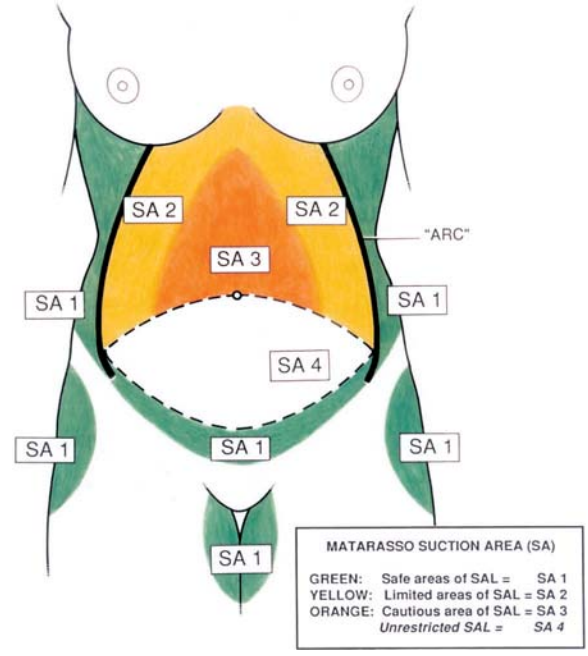


Fig. 6.4. The anatomic regions (suction areas) for suction lipectomy in abdominoplasty: *SA3* (cautious), *SA2* (limited), *SA1* (safe), and *SA4* (unrestricted) [10]

nant blood supply derives from the Zone III vessels and therefore suction of SA-3 is less reliable if suctioning is performed too vigorously. When extensive liposuction is necessary in a full abdominoplasty patient, staging the procedure or a panniculectomy with SAL should be considered as alternatives.

6.5 Preparation

Preoperatively, patients are instructed to avoid all medications that may induce bleeding as well as thrombogenic factors (i.e. female hormones). If they are smokers or use nicotine products, they are instructed to stop using these products several weeks prior to surgery and for at least 2 weeks postoperatively.

Patients are initially marked in a standing position to delineate the areas for liposuction and skin incisions for abdominoplasty. General or monitored intravenous sedation anesthesia administered by an anesthesiologist is preferred. A super-wet concentration of fluid (1 l of Ringer's lactate, 20 cc of 1% lidocaine and 1 cc of 1:1,000 epinephrine) for subcutaneous infusion is infiltrated. If liposuction is performed it usually precedes the abdominoplasty procedure.

At the end of the procedure, an anatomic data sheet is completed as part of the patient's chart [11] (Fig. 6.5). This permanent medical record is useful when recalling procedures performed and helps in monitoring success of techniques.

6.6 Choice of Surgical Technique

6.6.1 Type 1: Suction-Assisted Lipectomy

The ideal candidate for isolated SAL is one with minimal skin laxity, varying degrees of subcutaneous fat accumulation, and little to no flaccidity of the musculofascial system. Once SAL is performed on isolated fat deposits, the resiliency of the skin leads to contraction and improvement in overall contour (Fig. 6.6) [12, 13].

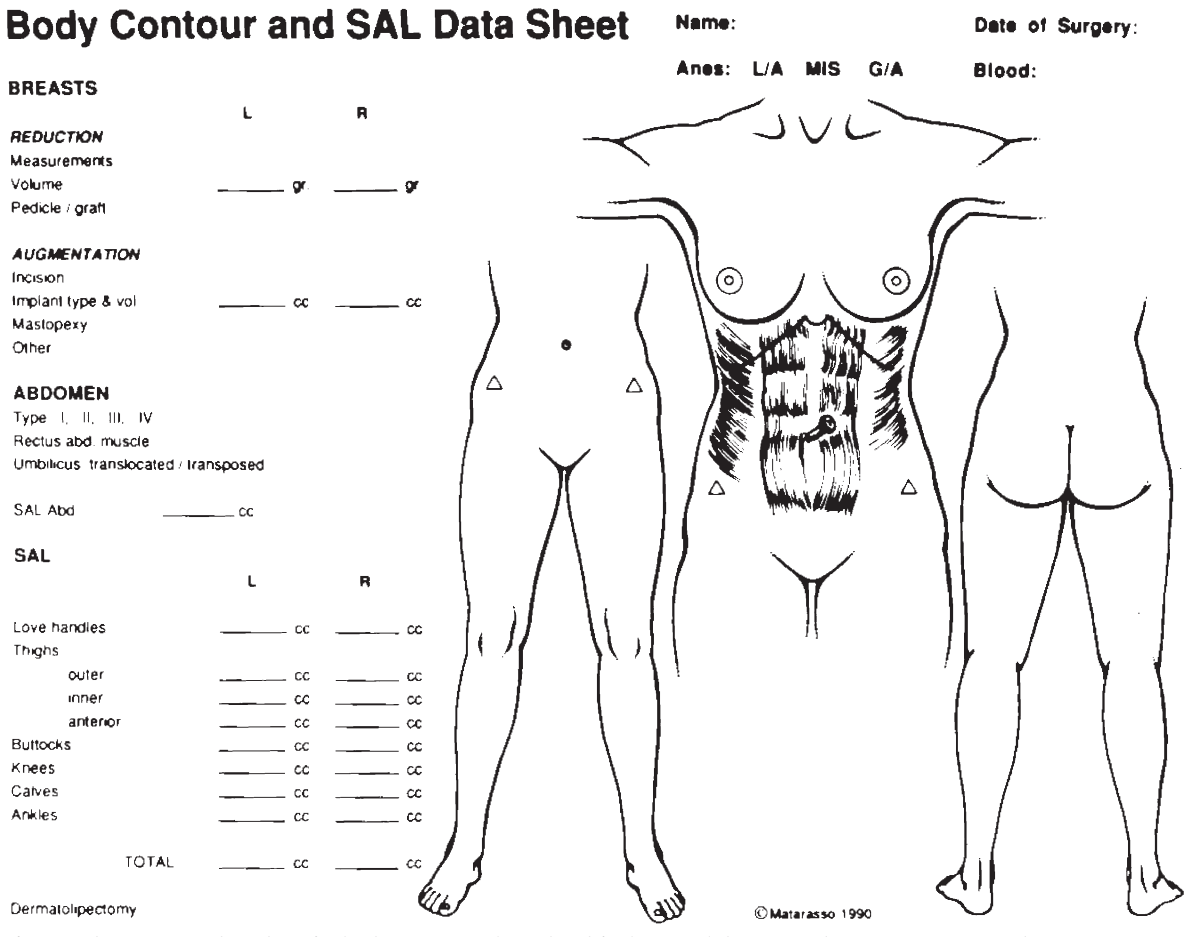


Fig. 6.5. The anatomic data sheet for body contour to be utilized for breast, abdomen, and extremity surgery. The accompanying checklist provides room for measurements, volumes, varying surgical techniques, and the type of implant used [11]

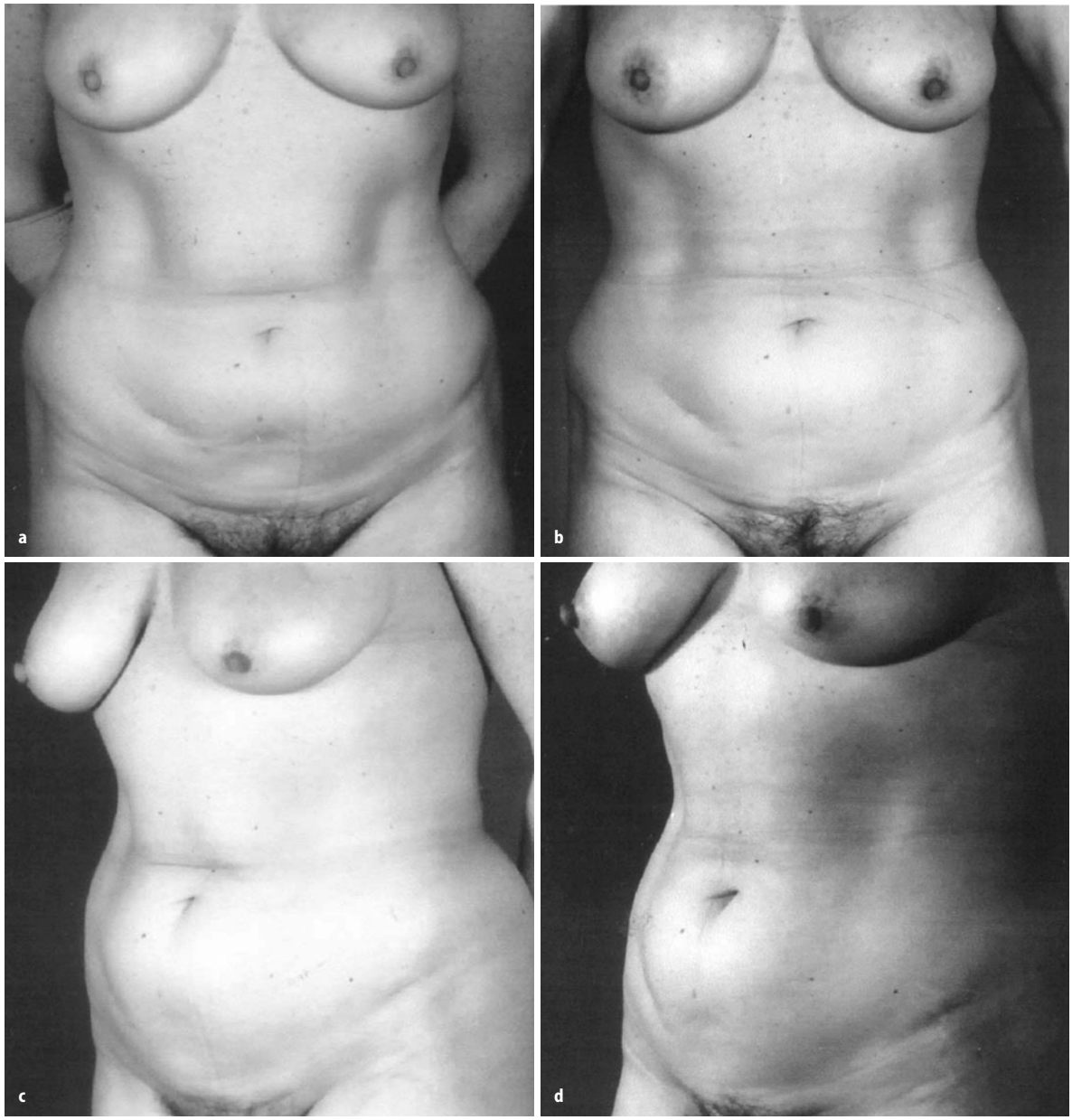


Fig. 6.6a–d. A 39-year-old, Type 1 patient 2 years following a 700-cc suction lipectomy of the abdomen. **a, c** Preoperative; **b, d** postoperative

SAL is often used as the initial surgical approach in all four categories of abdominolipoplasty procedures (Fig. 6.7).

6.6.2 Limited Abdominoplasty

When combining SAL with traditional abdominoplasty techniques, an additional 25 – 30 % of the patient population can benefit. In those patients in whom SAL alone would not correct the deformities, but a full abdominoplasty is too extensive, then Type 2 (mini-abdominoplasty) and Type 3 (modified abdominoplasty) are considered. While the techniques are similar, the presence of the umbilicus necessitates an additional category of treatment. Type 2, the mini-abdominoplasty, focuses on the lower abdominal musculofascial system, whereas the Type 3, modified abdominoplasty, allows for flexibility in treating the upper abdominal musculofascial system as well and excess skin in patients who are not candidates for a full abdominoplasty.

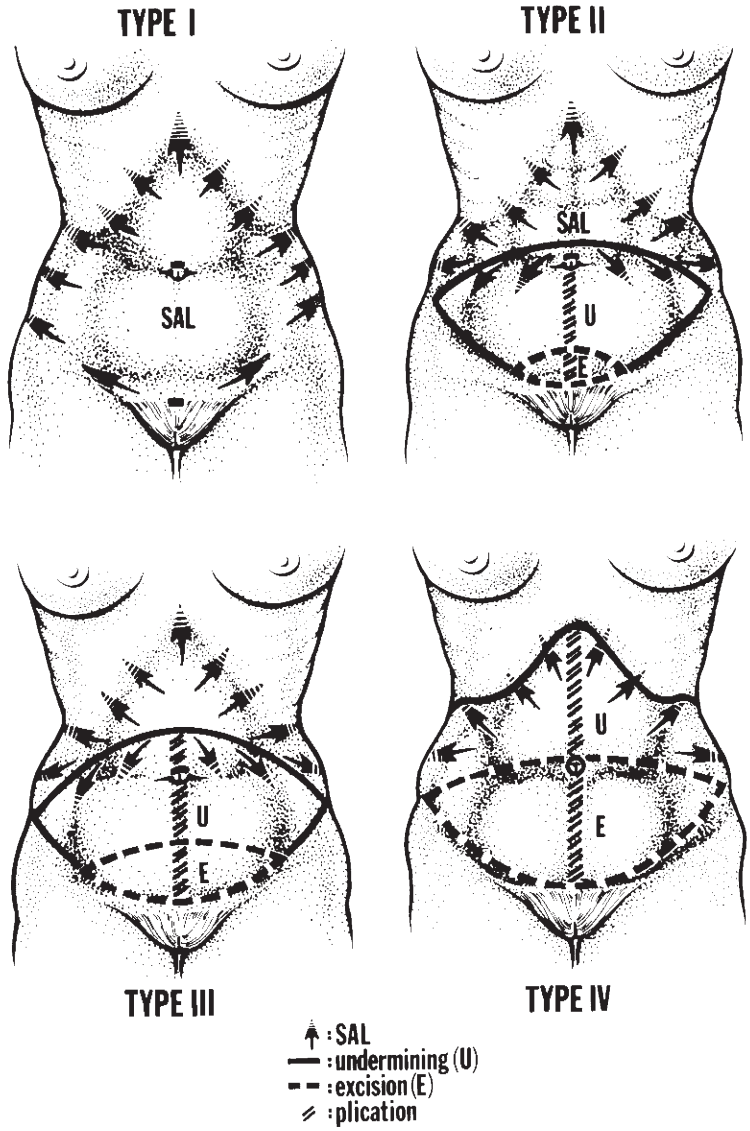


Fig. 6.7. Abdominoplasty types

6.6.3 Type 2: Mini-abdominoplasty

The ideal candidate for a mini-abdominoplasty is one with distortion limited to the caudal abdomen between the umbilicus and pubis. Patients best suited for Type 2 treatment require correction of a combination of minimal excess skin, variable amounts of subcutaneous fat, and relaxation of the lower abdominal musculofascial [14]. The bulge that is evident is primarily due to musculofascial flaccidity; therefore, SAL alone does not correct the deformity. Rather, these patients benefit from closure of the muscular diastasis. Observing the diver's view is often the best way to differentiate between Type 1 and Type 2 patients.

Liposuction is usually the first step in this procedure as is the case for Type 3 and Type 4. A curvilinear incision measuring approximately 5–10 cm is made in a premarked horizontal ellipse of skin adjacent to the pubic hairline. Occasionally Type 2 patients do not require fat removal or skin excision, and the exposure is solely for access to the musculofascial system.

The pre-marked area of skin excess is excised. The flap is then elevated at the anterior rectus fascial plane to the level of the umbilicus. Laxity of the rectus musculoaponeurotic system is evaluated and then vertically plicated with buried figure-of-eight 2–0 Neurolon sutures. The operating room table is slightly flexed, and the abdominal flap is secured with a 3–0 nonabsorbable suture to the lower incision. Closed-system suction drains are placed through the wound or pubic es-

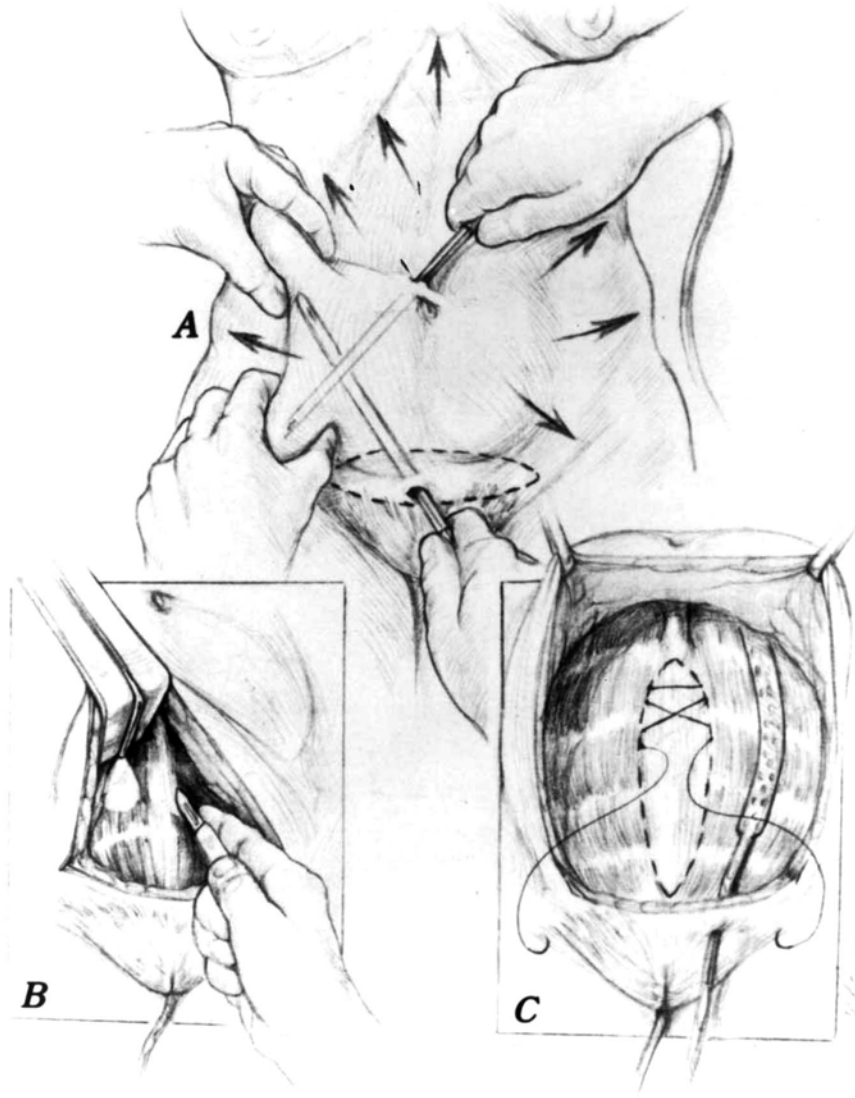


Fig. 6.8A–C. Surgical technique in a type 2, mini-abdominoplasty patient. **A** Surgery begins with liposuction over the aesthetic unit of the abdomen. Incisions can be altered to the patient's preference. **B** Flap is elevated to the level of the umbilicus with the aid of a lighted fiberoptic retractor. **C** The anterior muscle layer is reinforced vertically and occasionally horizontally. The flap is trimmed and closed over drains

cutcheon. The wound is closed from lateral to medial in layers with Vicryl, Prolene, and nylon sutures with a nonadherent gauze dressing. "Dog-ears" or discrepancies between the upper and lower flaps are treated secondarily (Fig. 6.8).

At the end of the procedure, the patient is transferred to a stretcher or bed and an elastic compressive binder is applied and worn continuously for at least 2 weeks. The patient is encouraged to be in a sitting position the night after surgery with progressive ambulation in a flexed position. The drains are removed when the drainage has subsided. Full activity is resumed in 2–3 weeks after surgery (Fig. 6.9).

6.6.4 Type 3: Modified Abdominoplasty

A patient who is a candidate for a Type 3 abdominoplasty presents with excess skin particularly above the umbilicus and flaccidity of the musculofascial system that extends from the pubis to above the umbilicus. This procedure also applies to a patient who in performing a full abdominoplasty would not be able to have removed the entire portion of skin encompassing the old umbilical site, thus necessitating an undesirable vertical slit closure. Additionally, general contraindications or abdominal scars that limit the extent of the safe upper abdominal flap undermining routinely in a full abdominoplasty are candidates as well (Fig. 6.10) [15].

A curvilinear incision is marked preoperatively in a natural skin fold with the patient in a lateral hip-flexed

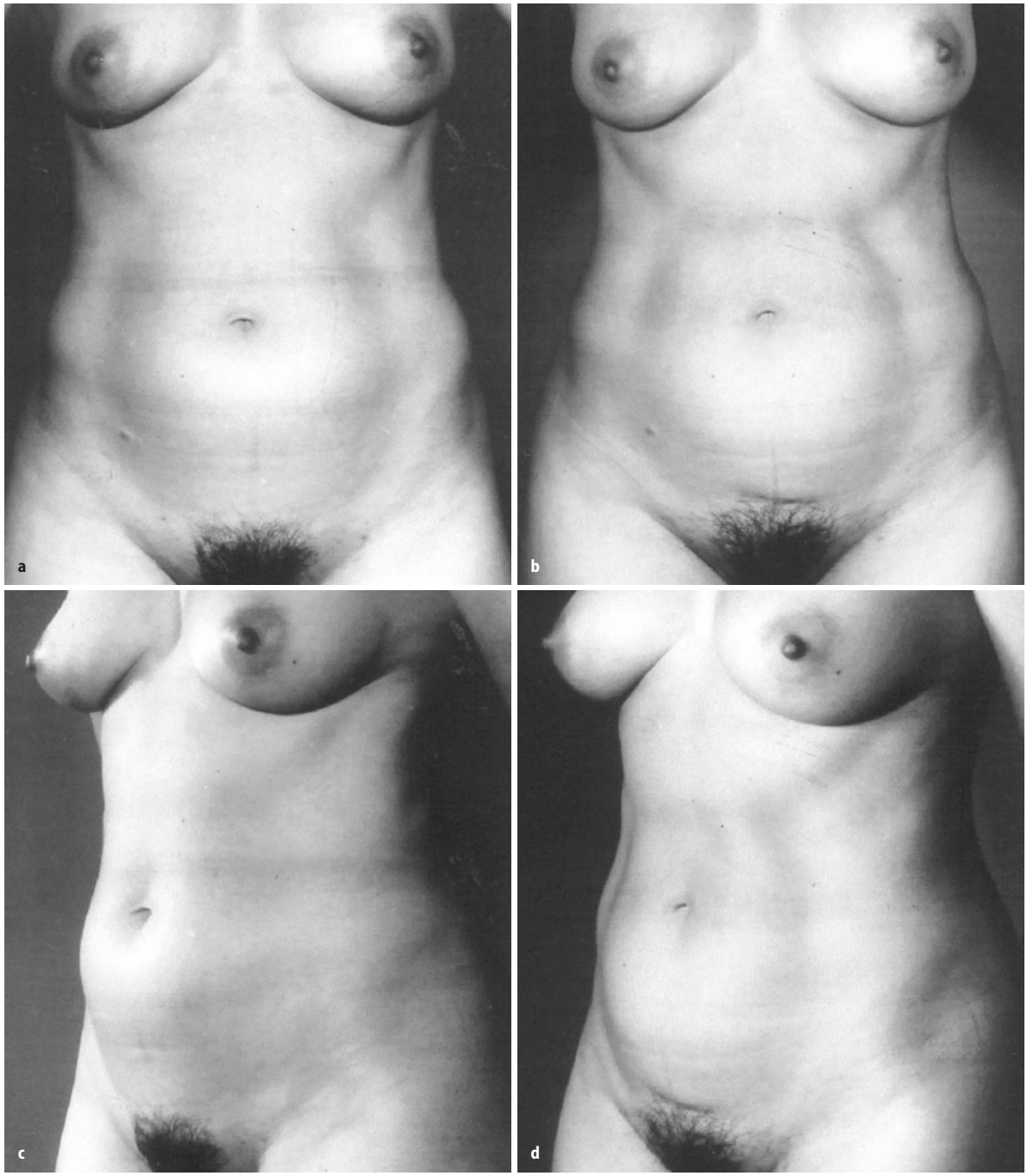
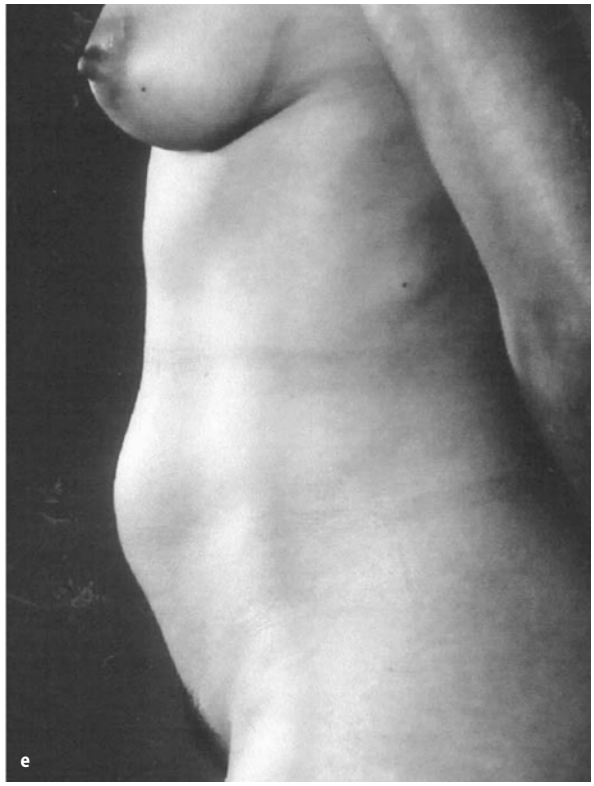


Fig. 6.9a–f. A 52-year-old Type 2 patient who had a mini-abdominoplasty with 600 cc of suction lipectomy. **a, c, e** Preoperative; **b, d, f** postoperative

position. The length of the incision is longer than that of a mini-abdominoplasty but confined within the anterior superior iliac spines. Brief undergarments may aid in adjusting skin excision within the boundaries of the garments.

Liposuction as in Type 2 is the first step. The flap is then elevated at the level of the anterior rectus fascial plane and undermined beyond the level of the umbilicus, which is beyond the extent of undermining in Type 2. The musculoaponeurotic fascia is then plicated. This plication can be extended above the umbilicus with an intact stalk by distracting the stalk inferiorly with a Penrose drain. Horizontal sutures for waistline narrowing can also be placed [16].

In long-waisted individuals, the umbilicus may be transected and floated downward. This maneuver is



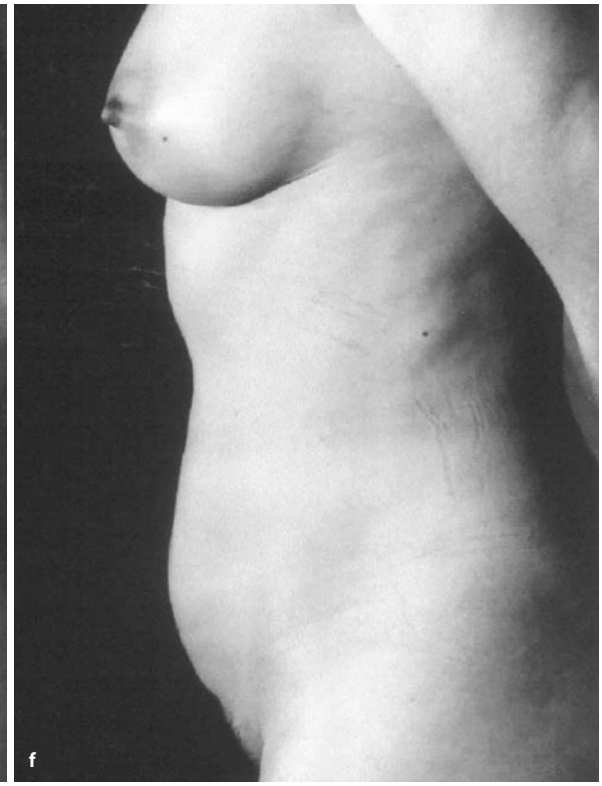
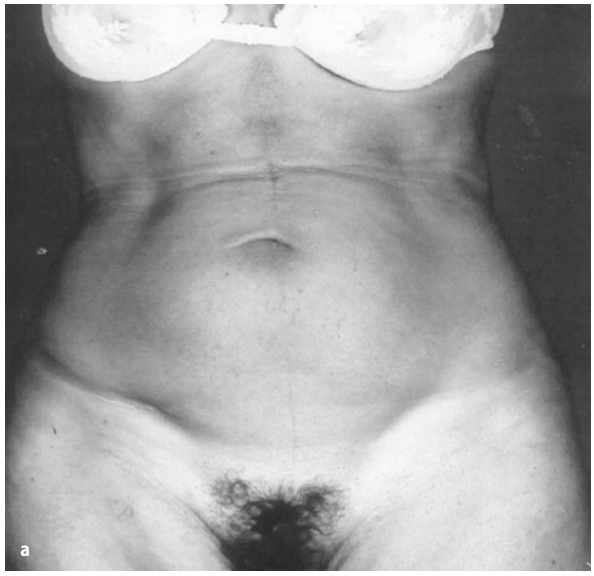


Fig. 6.9a–f (Cont.)



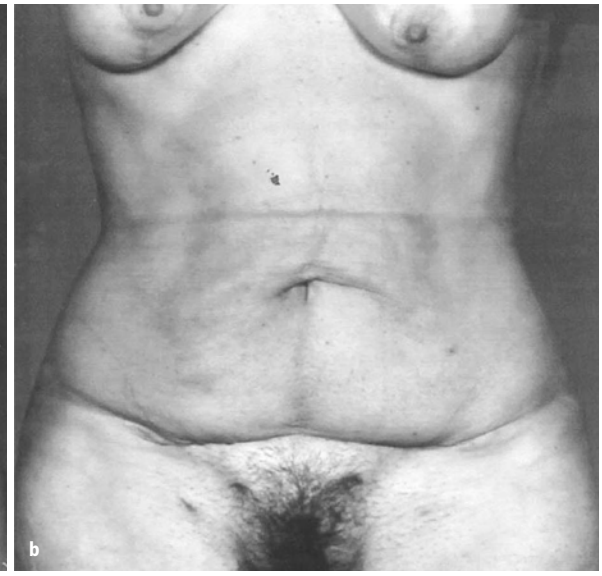


Fig. 6.10a–d. A 49-year-old, Type 3 female patient with a heavy smoking history who underwent a modified abdominoplasty and bilateral mastopexy with augmentation. **a, c** Preoperative; **b, d** postoperative

helpful in patients with excess skin in the periumbilical region and the upper abdomen. It is important prior to transecting the umbilicus that the area is palpated for hernias. After placing the umbilicus on maximal stretch the umbilicus is divided at its entry point into the rectus sheath. Once divided the entry point is then closed with a buried figure-of-eight suture. The umbilicus is then carried inferiorly no more than 2 – 3 cm below its original position generally 10 cm or more from the pubic hairline. After the rectus sheath is plicated, the um-

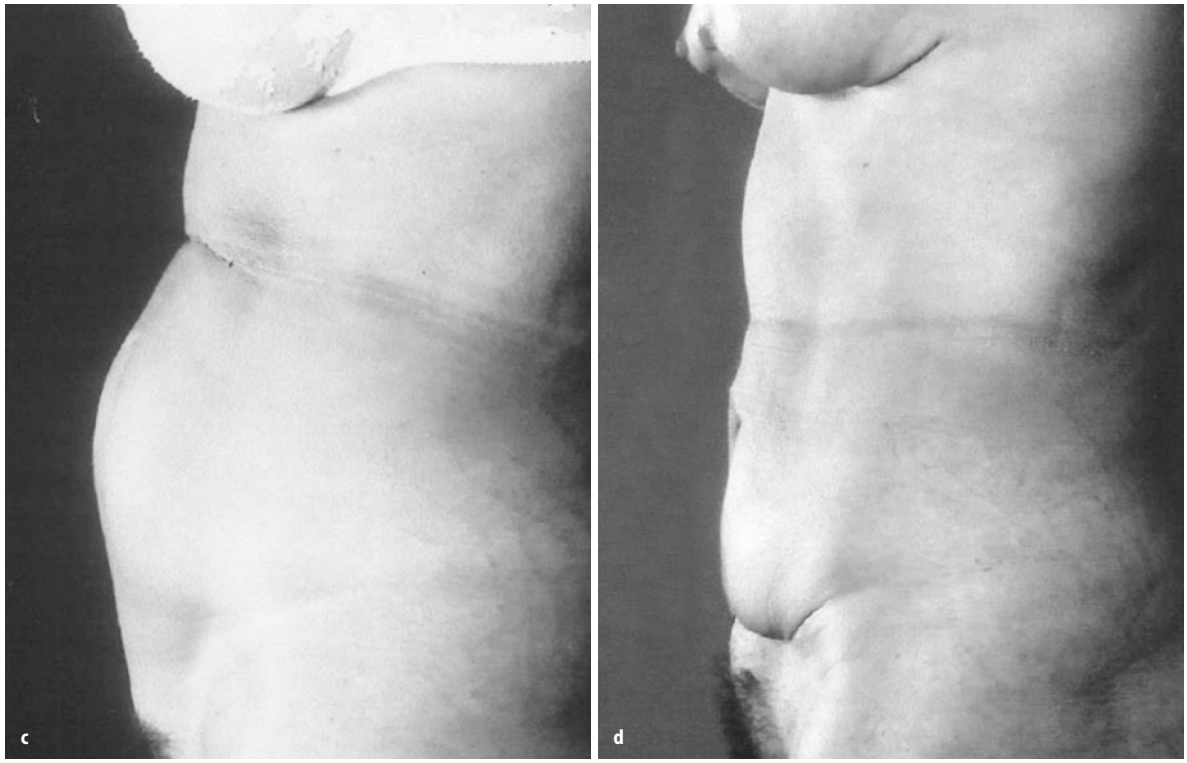


Fig. 6.10a–d (Cont.)

bilicus is reinserted to a level slightly higher than where it lies naturally using a 4 – 0 nylon to create an aesthetically pleasing downward pull and superior hooding.

The operating table is flexed to approximately 30 degrees and the flap is advanced inferiomedially. The excess skin is then measured, marked, and excised. Contour differences between the upper and lower flaps are equilibrated and the wound is closed in layers over closed-system suction drains. Postoperative care is similar to those having Type 2 procedures (Fig. 6.11).

6.6.5 Type 4: Full Abdominoplasty with Suction-Assisted Lipectomy

A patient with severe skin laxity and significant upper and lower abdominal musculoaponeurotic flaccidity is the ideal candidate for a Type 4 procedure. Grasping the skin from the umbilicus to pubis in this patient reveals the ease with which it can be excised. Consideration must be given to each stage of the procedure:

1. The need for SAL of the upper abdominal flap
2. Design of the incision and amount of skin resection
3. Fap elevation
4. Rectus musculoaponeurotic plication
5. Treatment of the umbilicus
6. Closure and final tailoring

The patient is marked in a standing position while wearing a preferred undergarment. Most commonly, an open W-incision [17], modified gull-wing incision [18], or a bicycle handle incision [19] has the advantage of exerting tension laterally preventing upward migration of the pubic escutcheon where vascularity is usually poorest. In addition, an incision in a natural skin crease is acceptable provided it is low enough to account for tension and unraveling of the flap. Furthermore, the incision should avoid crossing the inguinal creases.

The operating table is checked to insure that it can be maximally flexed prior to induction of anesthesia. Again, as in the other procedures described, liposuction is performed first, in areas 1 – 3 (Fig. 6.4). Surgery proceeds with circumscribing of the umbilical stalk. The abdominal flap can be treated in one of the following ways: (1) by removing the ellipse of skin from umbilicus to pubis; (2) by incising the lower margin in a classic fashion, undermining the flap, plicating the rectus fascia, flexing the table, and then removing the excess skin; or (3) by incising the upper margin, undermining the flap, advancing it inferiorly, then marking the lower incision in a vest-over-pants approach [21].

The abdominal pannus is elevated at the level of the rectus sheath usually to the xyphoid and costal margins; however, this may vary based upon the patient's needs. Most importantly, the flap should be elevated

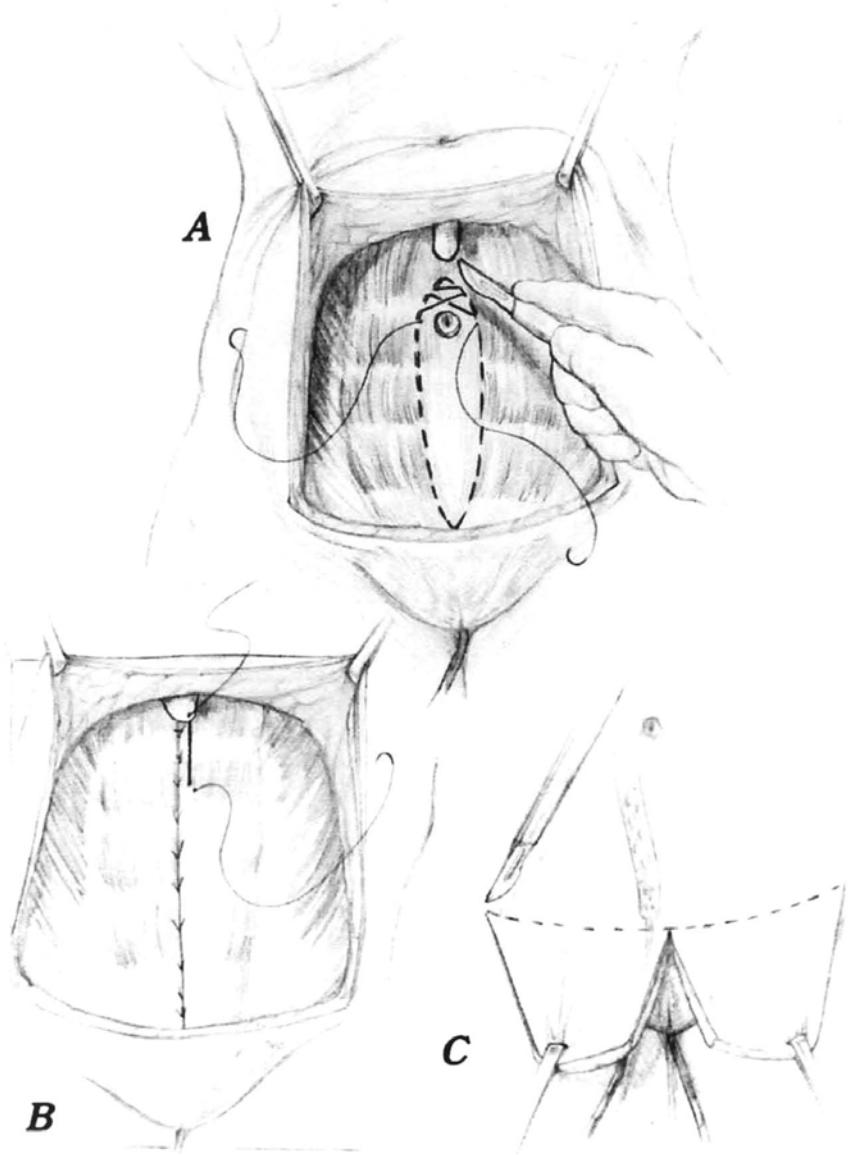


Fig. 6.11A–C. Type 3 modified abdominoplasty. **A** Longer incision is demarcated after performing liposuction. The umbilicus, which has a dual blood supply, can be left intact or detached at its base. **B** Musculoaponeurotic plication is then performed to the extent indicated. If the umbilicus is detached, it is reinserted. **C** Final flap tailoring is done with the patient flexed. Wound edges are pulled in the inferomedial direction

superiorly in an inverted "V" type fashion and laterally only to the extent necessary to achieve wound closure without tension. The patient then undergoes plication of the rectus muscle and any other plication that is necessary (e.g., waistline of external oblique tightening). The patient is flexed and the flap is advanced. After closed suction drains are placed and brought out through the wound, the excess skin is then excised and secured to the midline of the lower flap and closed in layers as in Type 2 and 3. When the lateral margins are closed, they are advanced medially to minimize any dog-ears. Minor discrepancies of flap thickness between the upper and lower wound margins can be treated at this time with liposuction. Sometimes scar revisions are performed secondarily when there is less tension on the closure (Fig. 6.12).

The mons pubis is then often defatted and unfurled, and along with the lower flap is stabilized with absorbable sutures to inhibit upward scar migration [22]. Sometimes, the mons can be reduced by excising a vertical or horizontal ellipse to bring it into proportion with the new contour of the abdomen [23].

The umbilicus is transposed into a downward curved 2.0–2.5 cm incision. In the past, half-buried mattress 4–0 nylon sutures were placed in the 4, 6, and 8 o'clock positions. These sutures were passed through the skin of the flap incorporating the rectus fascia below and passing up through the umbilical skin. This practice is no longer routinely performed because on long-term follow-up it has very little impact on the final result. If utilized, it is done on thin patients only at the 6 o'clock position. Furthermore, if a tacking suture

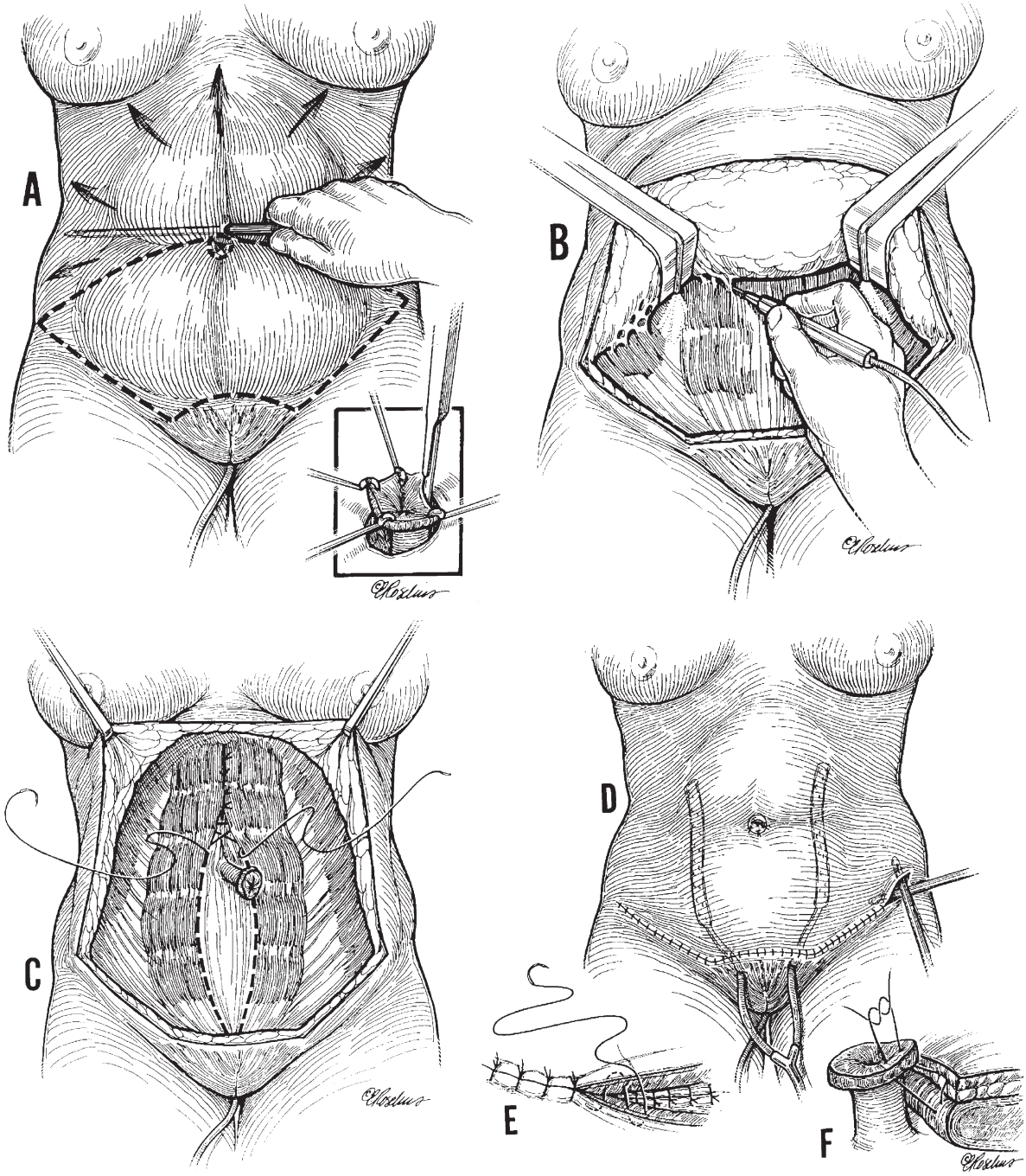


Fig. 6.12. Full abdominoplasty with concomitant SAL. **A** Surgery begins with liposuction, and proceeds with circumscribing the umbilicus. **B** Flap is then undermined only to the extent necessary to achieve wound closure without tension. **C** Muscular plication is performed according to the degree of laxity. **D, E** Patient in a flexed position with the wound closed over drains. Final tailoring can be done with liposuction. **F** Umbilicus is exteriorized and fascia sometimes is incorporated in the closure. The skin should be brought to the umbilicus after defatting the upper and lower margins [20]

pulls away from the fascia, it may distort the appearance of the umbilicus [23]. The umbilicus is closed using 4 – 0 nylon sutures from the umbilical skin and to the skin of the abdominal flap.

At the end of the procedure, the patient is transferred to their bed, which is flexed. Postoperative care is similar to that in Type 2 and 3. The patient progresses to full activity over a 3 – 4 week period (Fig. 6.13).

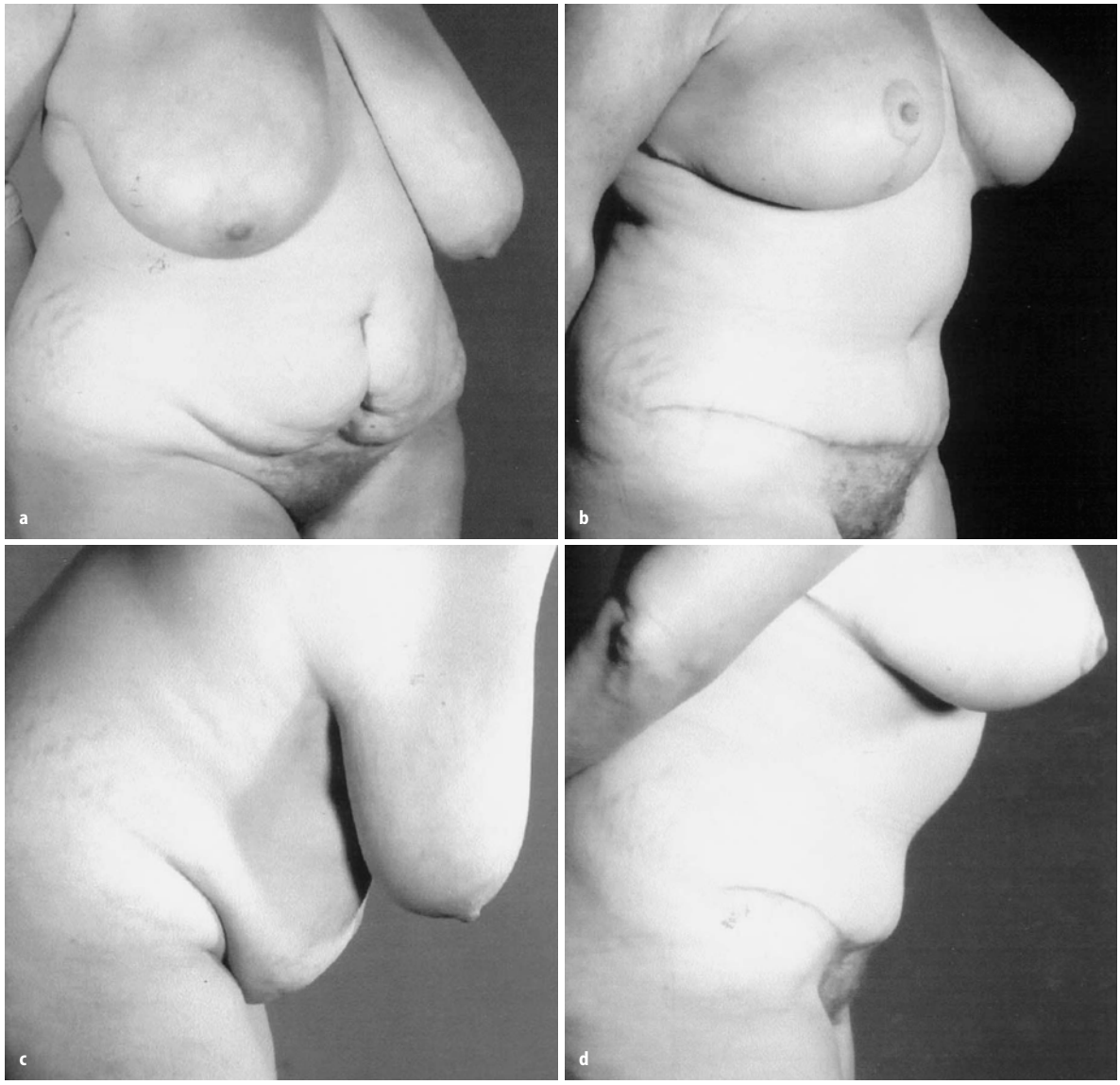


Fig. 6.13a–d. A 47-year-old, Type 4 abdominoplasty patient. Eight months after reduction mammoplasty, Type 4 abdominoplasty, with 700 cc of suction lipectomy. **a, c** Preoperative; **b, d** Postoperative

6.7 Minimal-Access Variations in Abdominoplasty

Although the majority of patients are treated according to the classification system previously described, there is a trend toward reduced intervention and minimal access, which has further subdivided these categories. These techniques increase the treatment options and result in smaller and fewer incisions (Fig. 6.14).

6.7.1 Type 1a: Extended Liposuction

This procedure is indicated in a patient who can be successfully treated by large volumes of fat removal without requiring skin removal or muscular plication. Patients who have "pseudoptotic" skin must be accurately distinguished from those with irreversibly stretched skin prior to undertaking extended liposuction. This approach takes into consideration treatment of multiple aesthetic units of the torso including the upper and lower abdomens, umbilicus, flanks, mons pubis, sacrum and/or back rolls (Fig. 6.15). It requires larger volumes of local anesthesia and more extensive lipo-

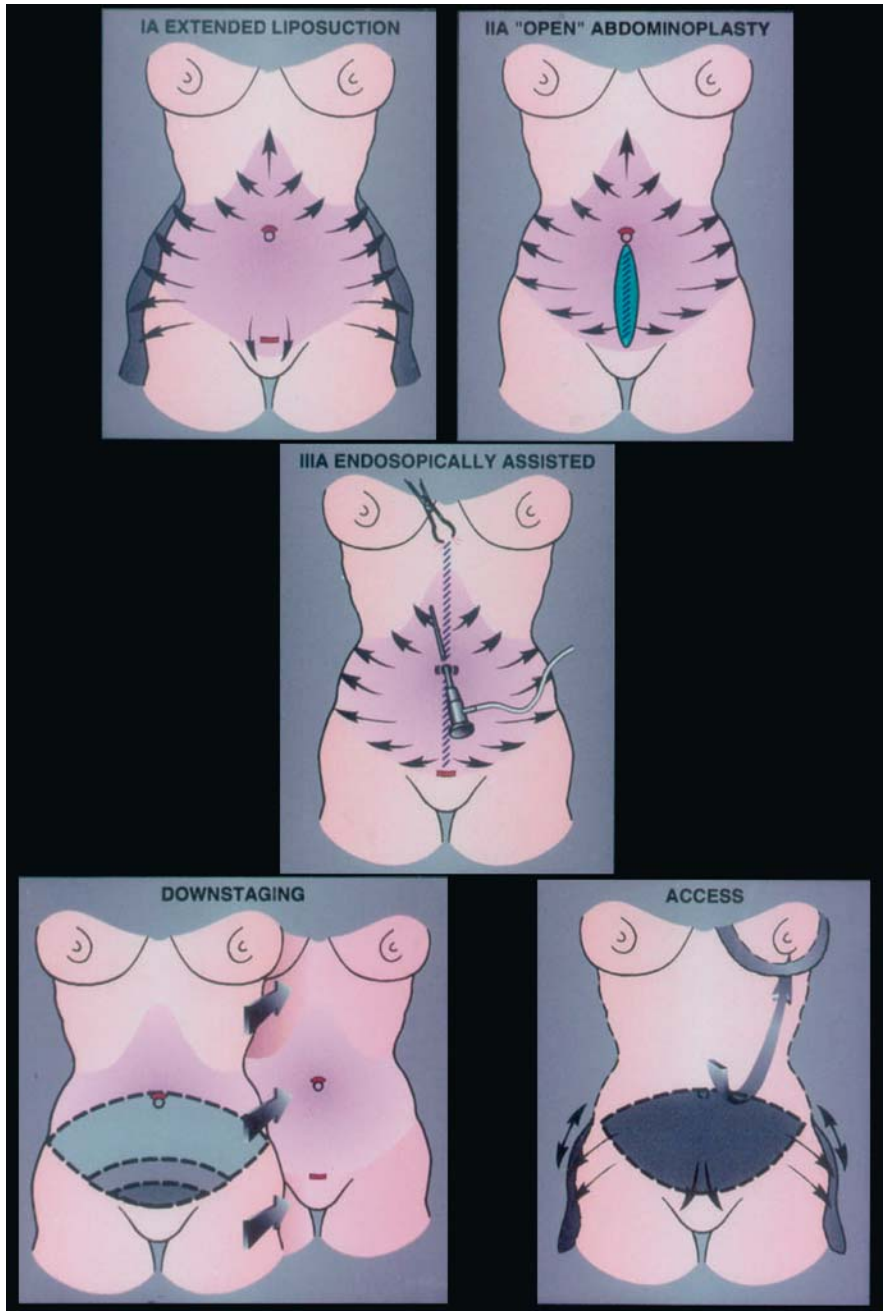


Fig. 6.14. Schematic of the subtypes. These minimal-access variations in abdominoplasty are related to the types of abdominolipoplasty from which they are derived: Type IA, extended liposuction; Type IIA, "open" mini-abdominoplasty; Type IIIA, endoscopically assisted or muscle access abdominoplasty. Downstaging procedures (from one type to a less invasive type of abdominoplasty) and the abdominoplasty incision for access related procedures (such as for adjacent liposuction) are also used [4]

suction than traditional limits. It can be used as an alternative to "open" approaches when an adequate result is anticipated. In contrast to liposuction ranging from 400 to 800 ml for the abdomen alone, extended liposuction usually exceeds 2,000 ml.

Surgery often begins in the prone or lateral decubitus position after super-wet infiltration of local anesthesia. Liposuction of the sacrum, flanks, and back rolls is performed in a "belt-like" fashion in the deep and superficial planes. The patient is then turned and placed in a supine position to treat the anterior abdomen. Suctioning of the mons and upper hips can also be treated at this time. The end point of suctioning is based on the potential for skin retraction as well as visual and tactile parameters.

If contour irregularities are appreciated, liposuction of adjacent areas may correct this discrepancy or a "squeezing" technique may be used to push adjacent fat into the depressed region. If these maneuvers are not successful, autologous fat injection into the depressed region may offer the solution.

At the conclusion of the procedure, the skin is then

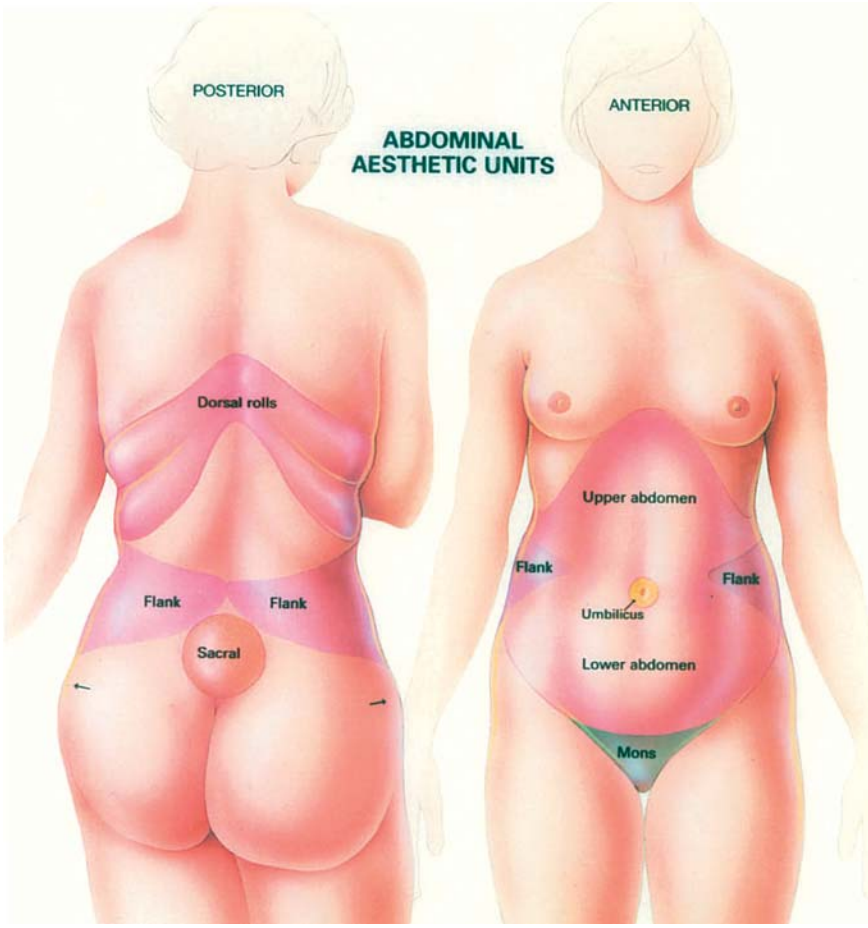


Fig. 6.15. The seven distinct circumferential aesthetic units of the female abdomen that should be addressed [6]

redraped and sometimes taped. Fluid is replaced as necessary and the suctioned sites are reinforced with binders as well as either Reston foam or towels between the garment and the skin. Postoperative care and recuperation is similar to those patients in Type 1 and 2 categories.

6.7.2 Type 2a: Open Mini-abdominoplasty

Indications for this procedure are for patients who are candidates for Type 2 but also have a midline vertical scar extending from the umbilicus to pubis. Vertical incision abdominoplasty is not new and has been described elsewhere [24, 25]. Type 2a patients have the deformity with mild skin laxity confined mainly to the lower half of the abdomen and relaxation of the musculoaponeurotic system limited to the region between the umbilicus and pubis as for patients in Type 2.

In the presence of a vertical scar it is essential as in all physical exams to rule out the existence of a hernia. The excess skin is estimated and marked for excision. Liposuction is again the first procedure performed if there is no evidence of a hernia. If a hernia is thought to be present, careful excision of the skin flap is performed, and repair of the hernia follows. Liposuction can then be performed through the open wound. The excess skin around the scar to the level of the rectus fascia is removed with undermining. The fascia is then plicated with permanent sutures. A closed-suction drain is placed and the incision is closed in multiple layers. Again, postoperative care is similar to that for Type 2 patients.

6.7.3 Type 3a: Endoscopically Assisted or Muscle Access Abdominoplasty

The ideal candidate for this procedure is a patient with minimal skin excess and upper and lower muscular flaccidity that can be addressed by fiberoptic and endoscopic instruments. The utility of this procedure is limited because often these patients have excess skin that must be removed. Moreover, the instrumentation has not been developed adequately for the sophistication necessary.

Surgery begins with liposuction, as necessary. Exposure for the endoscopic repair of the muscle is then ob-

tained via a pubic and peri- or transumbilical incision. A wide optical cavity is developed and the upper abdominal skin is retracted with towel clips externally. A 10-mm, 30-degree downangled endoscope is then inserted. A loop or endoscopic suture punch is used for the rectus fascia plication [25].

After the rectus fascia is repaired, any skin bunching can be freed by undermining to avoid a permanent irregularity. Closed-system suction drains are placed and garments and taping similar to Type 1a are used.

6.8 Additional Options for Smaller or Fewer Incisions

6.8.1 Downstaging

Downstaging to a less extensive procedure is made at the time of consultation. This may occur as a result of individual risk factors precluding a more involved procedure, or specific patient preference. Patients who have comorbid medical conditions, smoke, or have abdominal scars that may increase the risk of potential complications, or the inability of patient to tolerate more scarring or a more involved recovery period may find it prudent to downstage to a less invasive procedure. This most commonly occurs with patients being downstaged from an open procedure to liposuction alone.

6.8.2 Access Abdominoplasty

Using the abdominoplasty incision to accomplish procedures for other body parts such as for breast augmentation helps minimize the need for additional incisions elsewhere [27]. Liposuction of the flank and thigh can be done, extending the lower abdominal incision allows for some thigh tightening and finally this incision can be used to insert breast implants [4, 27, 28]. Although we have not found the need for its use, rectus fascia, dermal fat grafts, or free fat grafts may be harvested directly through this incision instead of harvesting fascia (tensor fascia lata) or fat elsewhere.

6.9 Special Considerations

There are several situations that do not fall into these categories [6]:

6.9.1 Men

Men tend to accumulate fat in the lumbar roll (flank or "love handle") between the second and fourth lumbar spines. The treatment of this area usually requires circumferential liposuction using large volumes of dilute local anesthesia with multiple entry points (usually five), use of sharper cannulas, alterations in positioning (prone, decubitus, and supine), multi-layer liposuction, and disinsertion of the restraining skin crease.

6.9.2 Umbilicus

Patients may complain of excess or damaged skin in the periumbilical region and are candidates for a Type 4 procedure. However, some patients are averse to the large incision from this procedure and fall into the downstaging category. Ways to treat this problem include a reverse abdominoplasty (best in patients who have preexisting inframammary scars), or an umbilical float procedure along with a limited lower skin excision that removes the excess skin. Sometimes, autologous fat injections in the periumbilical region or periumbilical skin excisions satisfy minor skin excesses.

6.9.3 Secondary Surgery

There are several circumstances in which this occurs. For instance, as a trade-off for undergoing extensive liposuction or "closed" procedures patients may then require revisions. Some patients who were appropriate candidates for liposuction and underwent the procedure return years later for treatment of the muscle or additional skin procedures. On the other hand, there are patients who have undergone abdominoplasty before the advent of liposuction and now require thinning of the abdominal wall.

6.9.4 Multiple Procedures

When combining an abdominoplasty with other procedures, consideration for performing these additional procedures should be assessed based upon the safety of these procedures alone as well as how the combination will affect the outcome. The additional operative time required for combined procedures is an important consideration that may contribute to the increased risk of complication such as thromboembolism.

6.9.5 Overhanging Pannus

These patients are often not ideal candidates for a type 4 abdominoplasty. As well they often possess a large intraperitoneal fat component that cannot be treated. Consideration for treatment includes direct excision of

the pannus with limited undermining as well as aggressive liposuction.

6.9.6 Postbariatric Surgery Patients

A new realm of plastic surgery is developing from the rapid growth of gastric bypass surgery to treat morbid obesity. The discussion for treatment of these patients is a book in itself. In brief, surgery for these patients should be delayed until their weight loss has stabilized. With the majority of these patients having severe skin redundancy and significant musculofascial laxity, many are best treated by circumferential lipectomy. Often this is one of many staged procedures that these patients will undergo to improve body contour as a result of significant weight loss.

6.10 Conclusions

A vast number of abdominal deformities can now be categorized and treated according to an abdominal classification system. Accurate diagnosis through careful screening and evaluation can lead to a straightforward treatment solution for most patients. With the addition of new technology over the past several years, modifications in the classification system have been made as these newer tools have allowed for less invasive procedures to be performed. Certainly, modifications of the treatment plan based upon specific patient requests and individual anatomic differences are always part of the decision making process; however, as for any operative plan, a classification of treatment options is often useful.

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Mini-abdominoplasty

7

Bruce A. Mast

7.1 Introduction

Contour irregularities of the abdominal wall result from a combination of several causative factors, including: pregnancy, ageing, gravity, weight changes and sequelae of surgical procedures involving the abdomen. The resultant irregularities of the abdominal wall consist of varying degrees of adiposity, loose or redundant skin and laxity of the musculofascial units [1]. When these components affect the majority of the abdominal wall, and particularly the supraumbilical region, a standard full abdominoplasty with or without liposuction is usually indicated. This procedure almost always necessitates a general anesthetic and is associated with a fairly high degree of discomfort and convalescence, frequently requiring an overnight stay in the hospital.

However, many patients present with more limited or isolated deformities confined to the lower abdomen. These patients can be treated very effectively with a mini-abdominoplasty, although liposuction for areas of added fat accumulation without excess skin may be needed [2]. Mini-abdominoplasty can provide these patients with excellent correction of their abdominal deformities with significantly less morbidity and faster recovery than that which is associated with a full abdominoplasty [3, 4]. This procedure can also offer an understandable compromise for the patient who is not an ideal candidate for mini-abdominoplasty, but is unwilling to put forth the physical or financial outlay necessitated by the full abdominoplasty [5].

7.2 Clinical Findings and Patient Selection

Ideal candidates for the mini-abdominoplasty are displeased with their lower abdominal contour, especially when sitting. Oftentimes, they are thin, physically fit and active, but distraught over their appearance in clothes due to the lower abdominal bulge. Full examination of the patient's abdomen is done in several positions: supine, sitting, standing, and the diving position. This provides a full appreciation of the degree of excessive soft tissue and the extent of musculofascial laxity. Careful palpation of the abdomen in the supine position allows assessment of rectus diastasis and the superior extent of the diastasis. It further permits detection of abdominal wall hernias. The sitting position will show a roll of excessive or loose soft tissue with a lower abdominal bulge that may not be noticeable in the standing or supine position. The excess of tissue confined to the lower abdomen is confirmed with the patient standing while downward traction is asserted to the abdominal skin, demonstrating the absence of sufficient laxity or excess above the umbilicus to bridge the gap to the pubis required for a full abdominoplasty. The diving, or waist-flexed, position allows the loose skin to fall away from the abdominal wall and provide further assessment. In general, musculofascial weakness and loose skin should be confined to the infraumbilical abdomen. Diastasis of the rectus should be limited to the umbilical region or only 1 or 2 cm superiorly (Table 7.1, Figs. 7.1 – 7.3).

Contraindications to mini-abdominoplasty are laxity of the abdominal musculofascial components above the umbilicus, excessive or disproportionate soft tissue in the upper abdomen, generalized laxity or soft tissue excess of the entire abdominal wall, upper abdominal hernias (usually incisional hernias) and the patient's presenting after massive weight loss. Such patients generally have excessive skin throughout the abdomen. As a general guideline, ptosis of supraumbilical skin over the umbilicus is indicative of excessive laxity of the upper abdominal soft tissue that would not be fully corrected with a standard mini-abdominoplasty (Table 7.2, Figs. 7.4, 7.5).

Table 7.1. Ideal candidate for mini-abdominoplasty

Clinical feature	Description
Body type	Overall fit and trim; not obese
Abdominal contour	Lower, infraumbilical bulge
Excess tissue	Confined to lower abdomen
Musculofascial laxity	Lower abdomen only
Rectus diastasis	No more than 2 cm above umbilicus

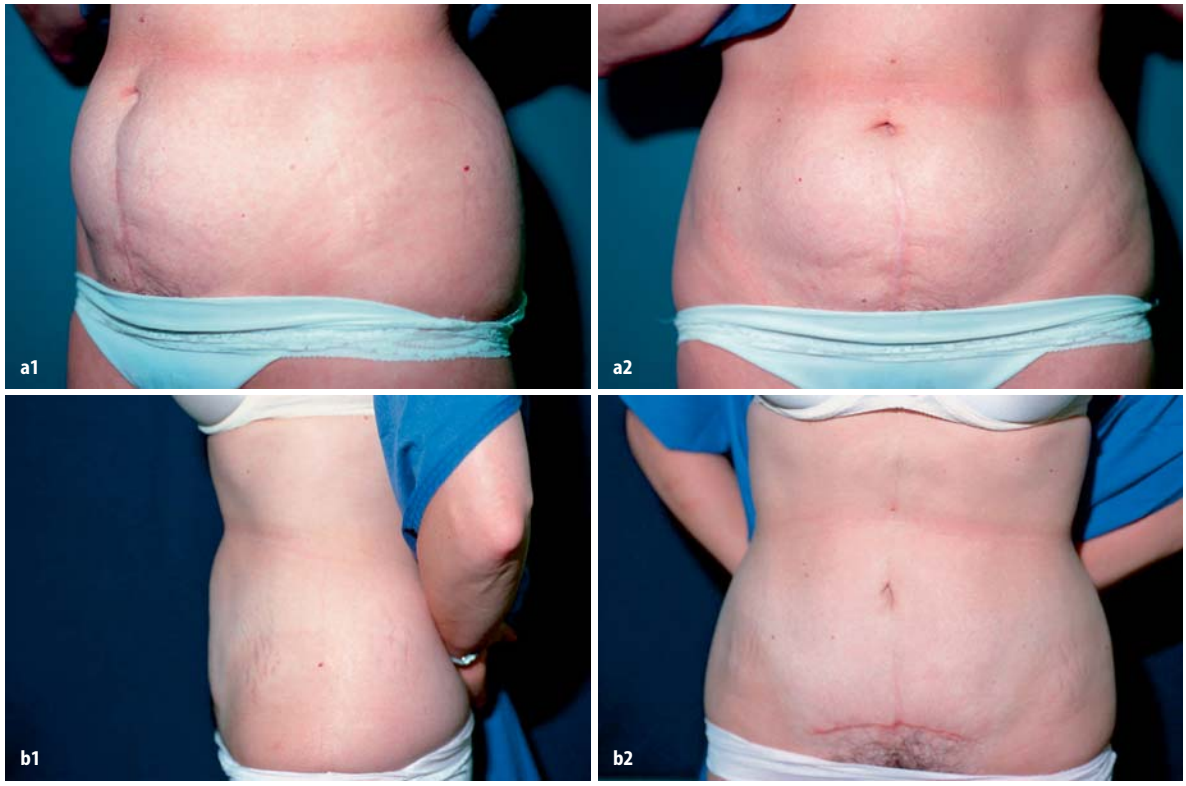

Fig. 7.1. a Preoperative ideal patient for mini-abdominoplasty; **b** postoperatively

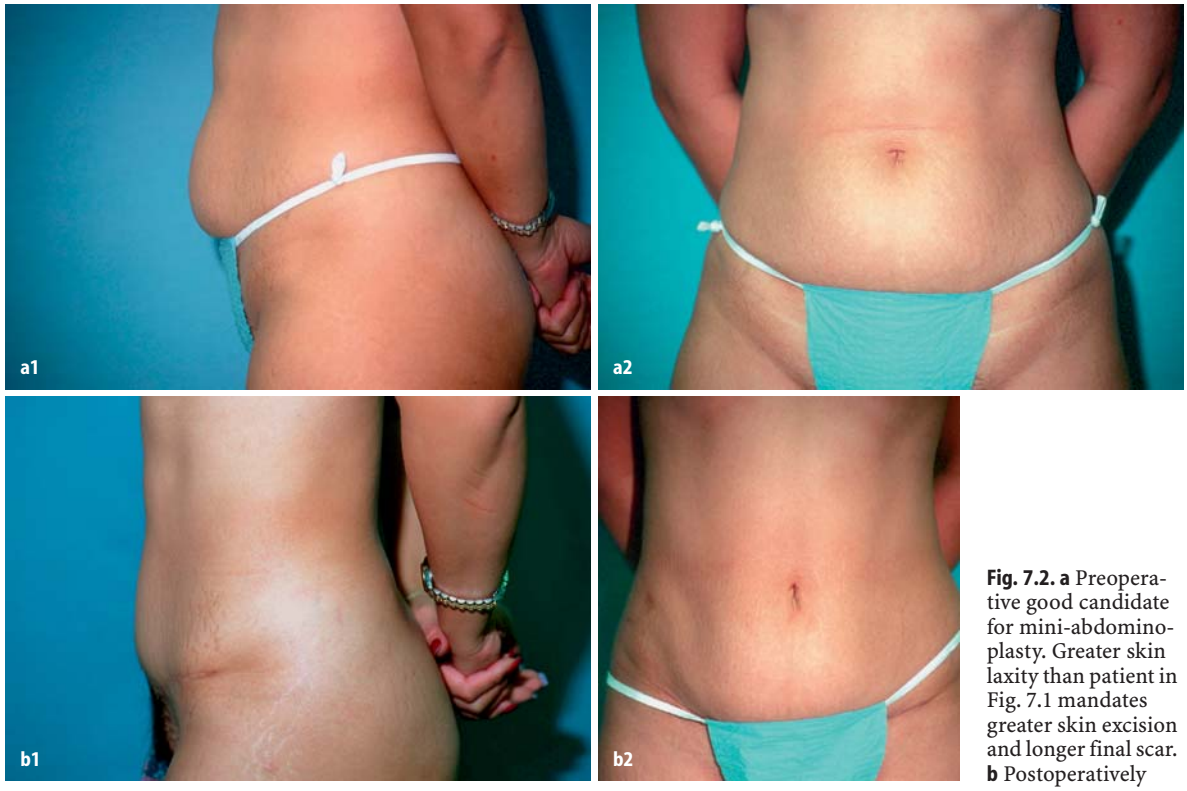

Fig. 7.2. a Preoperative good candidate for mini-abdominoplasty. Greater skin laxity than patient in Fig. 7.1 mandates greater skin excision and longer final scar. **b** Postoperatively

Fig. 7.3. a Preoperative, excellent candidate for mini-abdominoplasty. Very little redundant skin and fat, but diastasis clearly extends above the umbilicus. **b** Postoperatively

Table 7.2. Contraindications for mini-abdominoplasty

Clinical feature	Description
Body type	Obese
Abdominal contour	Excessive or disproportionate upper abdominal bulging
Excess tissue	Includes upper abdomen or entire abdomen
Musculofascial laxity	Involves supraumbilical abdomen; incisional/ventral hernia
Rectus diastasis	Extends well above umbilicus

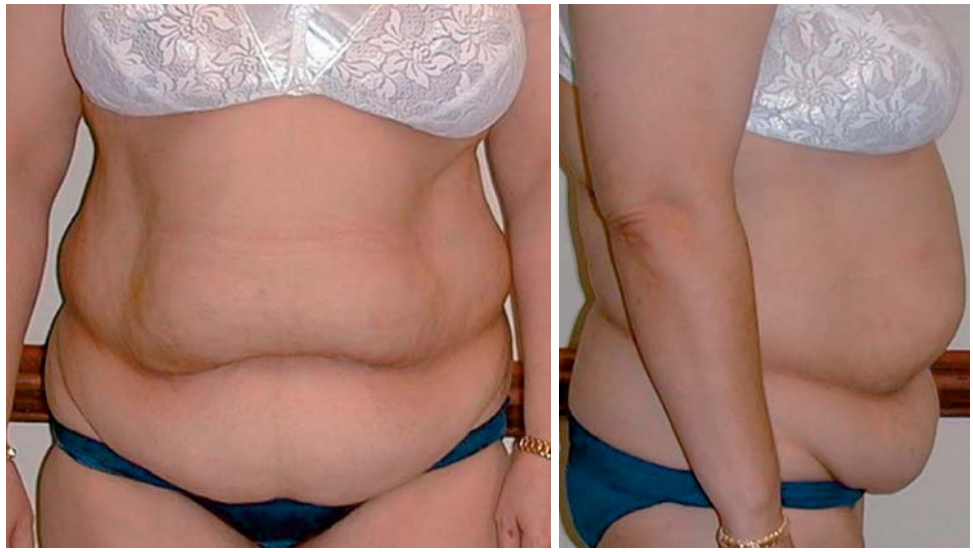

Fig. 7.4. This patient will obviously be inadequately treated with a mini-abdominoplasty. Excessive or redundant skin and adipose exists throughout the entire abdomen

Fig. 7.5. This 38-year-old woman has delivered triplets. Casual inspection is deceiving, while a full examination demonstrates the extent of the abdominal deformity. There is virtually no excess fatty tissue, but her skin is loose throughout the abdomen (note the mild ptosis of the skin above the umbilicus) and rectus diastasis rectus extends from pubis to xyphoid. Full abdominoplasty is indicated

7.3 Operative Technique

A mini-abdominoplasty in an ideal patient will be described. The author's preferred methods will be presented with alternatives discussed subsequently.

As with all body contouring procedures, the patient is marked preoperatively. In the standing position, the central transverse aspect of the inferior incision is marked at the superior border of the pubic hairline with the patient standing. This mark should be no higher than 6 cm above the superior aspect of the introitus in the midline. This will assure a final scar that is low and easily hidden in virtually any swimsuit. At the lateral aspects of the pubic hair border, the incision is curved down so that this portion is about 1 cm lower than the midline. In some patients, this incision length will be sufficient for the entire operation. More often, the incision will need to be extended laterally to allow visualization of the abdominal musculature and permit appropriate skin excision and closure. The lateral extension extends up the inguinal crease to about the level of the midclavicular line, but may need to be extended to the anterior superior iliac spine. It is best to have the patient wear her favored swimsuit during the markings, to assure that the final scars will be hidden. The upper excision line is not drawn until the flap is raised intraoperatively. However, for purposes of planning, the skin to be excised usually encompasses about one-third of the vertical height of the skin between the pubis and the umbilicus. Excision of more than this will likely lead to excess tension upon closure, causing upward migration of the scar or excessive distortion of the umbilicus. If liposuction is planned for the upper abdomen, iliac crests, or thighs, these areas are also marked while the patient is standing. All the markings should be demonstrated and explained to the patient with confirmation of scar placement.

Mini-abdominoplasty can be performed under several types of anesthesia. The author prefers a general anesthetic, but intravenous sedation combined with local anesthetic is also used [6–9]. In the latter technique, bilateral ilioinguinal nerve blocks are administered, combined with direct infiltration of the incision line with the local anesthetic. Tumescent liposuction solution is also infiltrated into the lower abdominal wall in the region of flap elevation. This augments the anesthetic affect and provides greater patient comfort [10, 11]. The use of epidural anesthesia has been sporadically reported, but the potential complications as well as possible prolongation of pre-discharge recovery must be considered (Table 7.3). If the operation to be performed is only a mini-abdominoplasty, then intravenous sedation combined with local anesthetic is easily applicable. However, if combined with liposuction, breast surgery or another procedure, then the total length of the procedure must be considered, affecting the selection of anesthetic, but also mandating consideration of prophylaxis for deep venous thrombosis and the use of body warming devices.

If liposuction of the abdomen is to be done, the standard tumescent technique is used. Suction is usually done prior to elevation of the lower abdominal flap, since this more readily allows the tumescent solution to remain in place without proximity to a large open surgical site, through which the fluid can easily egress. However, this may not be possible in the upper central abdomen without the use of a cannula access incision at the upper aspect of the umbilicus. If this is needed, the patient must be informed of this incision preoperative-

Table 7.3. Anesthesia used for mini-abdominoplasty

Type	Advantages	Disadvantages
IV sedation with local anesthetic	CRNA or anesthesiologist Limited time in recovery room Low incidence of postoperative nausea	Potentially more pain Muscular plication may be more difficult
General anesthesia	Maximum patient comfort Maximum muscular relaxation	Usually need anesthesiologist Higher potential for postoperative nausea Longer time in recovery room
Epidural	Excellent patient comfort Excellent muscular relaxation	Need IV sedation in addition to epidural Potential complications related to epidural Need specialized anesthetist/anesthesiologist

ly. In contrast to a standard full abdominoplasty, the upper abdomen can be suctioned fairly aggressively since the abdominal flap will not be elevated much above the umbilicus. This preserves perforating vessels that perfuse the abdominal skin such that the risk of ischemia is very low. If an abdominal wall hernia is present, this must be repaired prior to the liposuction to avoid intestinal injury.

Upon completion of the liposuction, the abdominal incision is created and carried through Scarpa's fascia down to the loose areolar plane just superficial to the anterior rectus sheath and external oblique fascial aponeuroses. The skin and subcutaneous tissues are then elevated off the abdominal fascia superiorly and laterally. The superior extent of mobilization is to the point where the diastasis recti cease, usually no more than a few centimeters above the umbilicus. If supraumbilical dissection is necessary, the umbilicus remains attached to the abdominal skin and the muscular wall, and care must be exercised around the umbilical stalk to avoid devascularization. Lateral mobilization of the flap is continued to about the level of the anterior axillary line. If the anesthesia being used is intravenous sedation with local anesthetic, electrocautery should be avoided in ligation and division of larger perforating vessels since these often contain sizable sensory nerves. The electrical current is transmitted into these nerves causing severe pain, despite the rest of the field being completely anesthetic. In such circumstances, suture ligation and sharp division should be employed. These procedures will allow sufficient anterior retraction of the skin unit such that abdominal wall plication can be done under direct visualization.

Dissection and retraction of the abdominal skin flap permits inspection of the musculofascial component of the abdominal wall and the anatomic cause of laxity that contributes to the abnormal external contour. Rectus diastasis is primarily confined to the infraumbilical region, although some patients may have a more minor aspect extending above the umbilicus. However, even in these patients, the majority of the laxity is in the lower abdomen. The laxity is corrected by musculofascial plication, providing reconstruction of the correct anatomic relationships of the abdominal wall musculature. This should result in parallel alignment of the rectus muscles with a straight-line juxtaposition at the linea alba. Accordingly, plication is undertaken to remove the resultant bulging and restore a flat abdominal wall. The plication lines on the anterior rectus sheaths are marked to guide suture placement. The elliptical or crescent marks come together in the midline just above the suprapubic incision line and meet superiorly at the upper aspect of the diastasis (Fig. 7.6). The plication is done with inverted figure-of-eight braided nylon sutures. These permanent soft sutures require few knots, avoiding postoperative palpability, even in the thinnest patients. Alternatively, a running permanent monofilament suture can be used. If plication is necessary superior to the umbilicus, sutures must be carefully placed so as to avoid strangulation of the umbilical stalk (Fig. 7.5). Others have described methods of vertical and transverse plication that may be applicable when the extent of laxity is not fully corrected by a standard midline plication [12].

Following plication, the excessive skin and subcutaneous tissue is retracted inferiorly to overlap the lower suprapubic incision. Aggressive excision that results in a very tight closure should be avoided. This could cause gross distortion of the umbilicus or unfavorable scar-

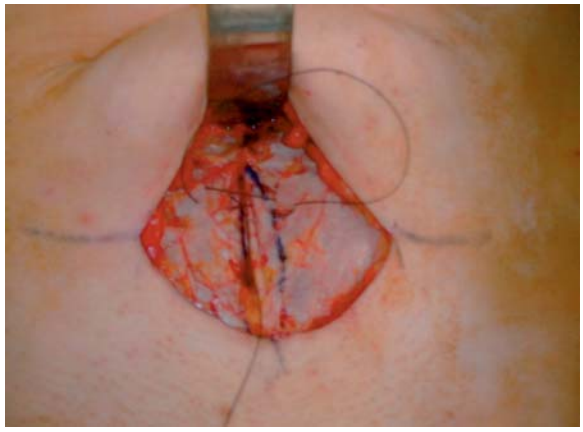

Fig. 7.6. Plication of the diastasis of the rectus muscles

ring due to tension. A very tight closure could also lead to superior migration of the scar as the looser pubic soft tissue is "pulled" upward. Such a circumstance could lead to a scar that is difficult to hide in the patient's swimsuit of choice. To avoid these results, skin excision is judged with the patient flat without the operating table flexed. With the flap retracted appropriately, the midline point of excision is marked and the flap is incised longitudinally in the midline. This point is secured temporarily to the lower incision line in the midline. This leaves two lateral "triangles" of excess tissue that can be appropriately marked and excised.

Prior to closure, it is occasionally necessary to judiciously de-fat the advancing abdominal flap or the pubic soft tissue centrally to provide an appropriate contour. A closed suction drain is placed via a small incision within the pubic hair. Scarpa's fascia and the subcutaneous aponeurosis are approximated with interrupted absorbable suture, incorporating the abdominal fascia in the midline to stabilize the position of the scar. This is followed by a standard layered closure of the skin. The soft tissues surrounding the suture line are infiltrated with bupivicaine to provide postoperative analgesia. In all cases, the umbilicus will be distorted to some degree, usually with a slight vertically elongated appearance (Figs. 7.1 – 7.3). An umbilicus to pubis distance of 9 cm is a good parameter to use for a "normal" anatomic relationship that provides a pleasing appearance. If this distance is significantly less than 9 cm, particularly in shorter patients, then translocation to the appropriate position through a vertical, elliptical, midline incision may be necessary. Overall appearance within the parameters of the patient's particular body habitus dictates the necessity of umbilical translocation, and preoperative assessment should allow counseling to alert the patient to the potential need for this maneuver and the resultant scar.

7.4 Postoperative Care

An abdominal binder or appropriate liposuction compression garment is placed after the surgery. The patient is discharged home after post-anesthesia criteria are met and instructed to leave the dressings and compression in place until seen for the first postoperative office visit, within 48 h of the procedure. The patient is instructed to avoid strenuous activities and heavy lifting for at least 1 month after surgery. The surgical drain is usually removed within 1 week. After 1 month of healing, the patient is permitted to gradually resume a workout regimen and is cleared for all activities as tolerated after 6 weeks of healing.

Virtually all complications or adverse outcomes that can occur with a full, standard abdominoplasty or liposuction also apply to mini-abdominoplasty, but occur much less frequently, since the surgery is not as extensive. The mini-abdominoplasty uses incisions and dissections that are considerably smaller while abdominal skin resection is of lesser quantity permitting the patient to remain completely supine or erect following surgery. This results in less pain and discomfort and affords a quicker recovery such that most patients can return to work within 7 days. Since the flap elevation is somewhat limited, hematomas, seromas, flap ischemia and wound dehiscence occur very infrequently, less than 10 % of the time [3]. Additionally, the mini-abdominoplasty minimizes potential adverse aesthetic outcomes that occasionally occur with full abdominoplasty, such as straightening of the waistline, incisional dog-ears, and difficulty concealing scars within swimwear. Nevertheless, suboptimal results can occur as with any body contouring procedure. Upper abdominal bulging may result from overzealous musculofascial plication causing intra-abdominal decompression via a less tight upper abdomen. Additionally, some patients may still have residual skin excess or lower abdominal bulge, usually due to their preoperative condition being more amenable to a mini- rather than full abdominoplasty, but not being the "ideal" candidate for the mini-abdominoplasty. For such patients, careful preoperative assessment and counseling on the limitations of the procedure is vitally important. Maximum scar quality is achieved by avoidance of excessive tension at closure, complete elimination of ultraviolet radiation (including tanning booths) for at least 6 months following surgery and the use of various scar lotions/gels or silicone patching for scar management.

As with most deformities treated by plastic surgery, it is important to analyze each deformity based on its various components and "customize" procedures to each particular patient. The mini-abdominoplasty represents such an approach. With careful patient selection, a significant aesthetic deformity can be corrected with minimization of morbidity and convalescence, while providing the patient with a high standard of care and a high level of satisfaction.

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8 Full Abdominoplasty

R. Jobe Fix, John M. Anastasatos

8.1 Introduction

For the patient seeking abdominoplasty, there is a list of common desires: a desire to decrease loose, draping skin, have a tighter, flatter abdomen and improve the abdominal contour. It is well recognized that exercise and diet are the best strategies to ensure many of these goals. However, despite appropriate exercise and diet, certain groups of people cannot reach these desired goals. Weight loss can decrease the subcutaneous fat layer and intra-abdominal volume but cannot improve loose, draping skin. Also, pregnancy induces changes in the vertebra column, ribs and pelvis resulting in an enlargement in the transverse diameter of the abdomen. The tone of the musculoaponeurotic system may be weakened [1]. In addition; operations on the abdominal wall and hernias may further weaken and partially denervate the musculoaponeurotic system [2]. The standard abdominoplasty is one of many techniques used for abdominal aesthetic surgery. This procedure, which consists of dermolipectomy and musculoaponeurotic tightening, is extremely effective in restoring the abdomen to its youthful shape in most patients.

8.2 Indications

The appropriate patient for standard abdominoplasty has excessive, loose, sagging, abdominal skin, lax abdominal fascial wall and/or diastasis recti [3]. Typically there is pronounced skin laxity; more than 6–8 cm of skin needs to be excised in the vertical dimension. Extensive undermining is necessary to provide exposure to a lax abdominal wall and to allow redraping of the skin. The muscular aponeurotic system, subcutaneous fat thickness, and skin are analyzed. Each system is addressed with the standard abdominoplasty.

General indications for abdominoplasty include the improvement of body contour, removal of redundant skin, removal of excess adipose tissue and removal of scar deformities including striae. Specific indications for the standard abdominoplasty are the following: excessive, loose, draping, abdominal skin which requires greater than 6–8 cm of excision in the vertical dimension; marked epigastric fullness; significant supra- and infraumbilical skin laxity and musculoaponeurotic relaxation; and ventral hernia with abdominal wall relaxation.

In recent years we have observed the increasing success of bariatric surgery. Following significant weight loss, these patients require marked contouring of the trunk. A standard abdominoplasty is often a part of the body contouring procedure for this group of patients.

8.3 Preoperative Evaluation

The preoperative evaluation may highlight some important considerations. An estimate of the vertical amount of skin to be excised is made by the pinch test. Presence of flank rolls or fullness is noted which may require liposuction or extended lateral excision. Abdominal scars, which may compromise skin flap viability, are noted. Ventral hernias are ruled out by exam in the upright and supine position, with and without Valsalva maneuver. A thick subcutaneous fat layer may obscure a hernia. Musculofascial laxity is most noticeable from the lateral view with the patient bent forward at the waist. Muscle firmness and diastasis recti can be evaluated in the supine sit up or leg lift position. If the fat layer is thin enough, the rectus borders may be seen. Lumbar lordosis may contribute to an apparent lax muscle wall. The patient may be classified as short waisted or long waisted depending on the vertical distance between the iliac crest and thoracic cage in proportion to the pelvic width. The skin flap design may be adjusted according to a long or short waist to provide the most pleasing frontal contour.

8.4 Skin Markings

Preoperative markings in the standing position are placed prior to surgery [4]. A low transverse suprapubic inferior incision is marked. Lateral ends should be turned up to avoid crossing the inguinal crease. With the patient in the standing position, it is helpful to mark the midline from xyphoid to umbilicus to the anterior vulvar commissure (Fig. 8.1). Two transverse lines are marked, one just above the umbilicus perpendicular to the midline from lateral rectus edge to contralateral rectus edge and a lower transverse line in the low transverse position, which is usually 5 – 7 cm above the anterior vulvar commissure (Fig. 8.2). The length of this line is kept the same length as the superior transverse line, thus marking out a grid on the abdomen. When the lower line is marked, traction should be placed by an assistant upward on the abdominal skin. Now a gentle curving line is drawn from the ends of the low transverse line up toward the iliac spine, either lateral or medial to the anterior spine depending on the abdominal contour. The lateral edges are adjusted to fall within the lines of the patient's usual undergarments and bathing suit. Tan lines are helpful in adjusting the lateral ends. An estimate of the position of the superior edge is marked at or slightly above the umbilicus. The superior line is drawn in a gently curving fashion down to the lateral apex of the inferior line. The more the lateral ends are turned up, the less the waist is narrowed in the frontal view. Less narrowing of the waist may be desirable in the short waisted abdomen or the abdomen with a short vertical height. Areas that are to be liposuctioned are marked with crosshatching (Fig. 8.3).

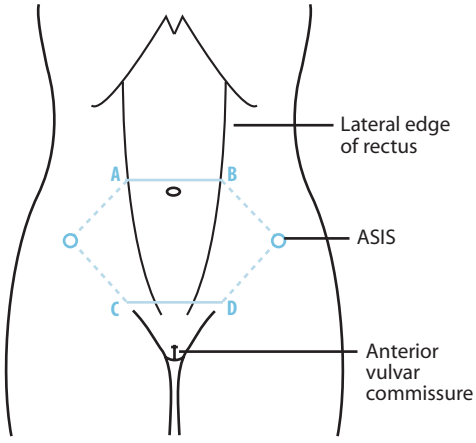

Fig. 8.1. Skin markings and landmarks

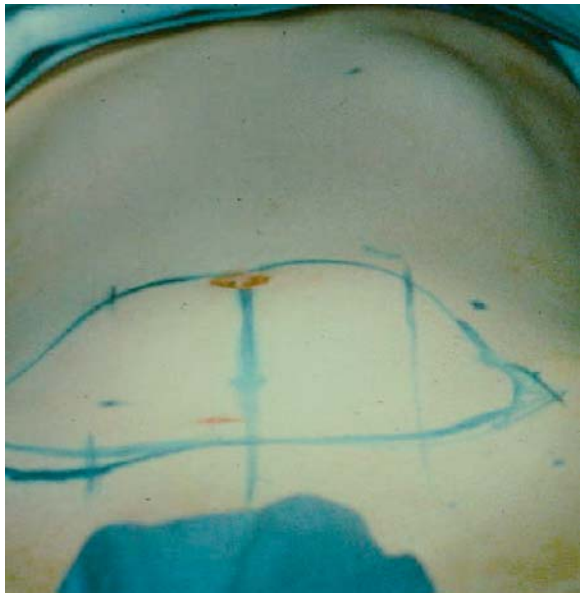

Fig. 8.2. Intraoperative photograph of skin markings

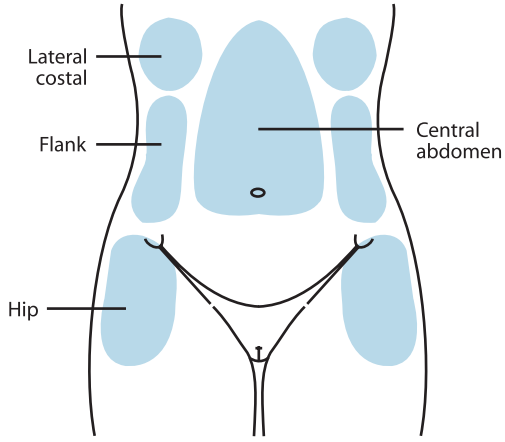

Fig. 8.3. Liposuction of the central abdomen to improve upper abdominal fullness. Liposuction of only one of the remaining collateral circulation zones (lateral costal, flanks, hips)

8.5 Surgical Anatomy

The vascular territories of the abdominal wall are divided into three areas based on the origin of their vascular supply. This description comes primarily from the work of Nahai, Brown and Vasconez [5]. Zone I covers the area from the xyphoid to the pubis overlying the rectus muscles and is supplied primarily by the deep epigastric arcade. Vessels coming from the lateral abdominal wall supply secondary perfusion. Zone II covers the area across the lower abdomen below a line drawn at the level of the anterior iliac spine and limited inferiorly by the pubic and inguinal creases. The exter-

nal iliac artery supplies Zone II via the superficial epigastric, the superficial external pudendal arteries, and the superficial circumflex iliac artery. Zone III bilaterally covers an area around the flank lateral to Zone I. Intercostal, subcostal, and lumbar arteries perfuse zone III. The venous and lymphatic drainage follows a concomitant pattern of the arterial supply. The motor and sensory innervation is derived from the lower seven thoracic intercostal nerves and the iliohypogastric branch of the first lumbar nerve. The motor nerves run in the layer of the internal oblique toward the lateral edge of the rectus muscles.

The umbilicus has a very rich central vascular supply. The perifascial plexus as well as preperitoneal vessels supply it.

The importance of describing this vascular anatomy of the abdominal wall is to maintain at least one of the zones intact to perfuse the abdominal skin and fat. This identifies the importance of maintaining the circumflex iliac vessels in the lower lateral abdomen and the more lateral vessels of the flank and lateral costal regions.

8.6 Operative Technique

The patient is positioned supine with pillows under the knees to relieve stress on the sciatic nerve if the table is to be flexed. The abdomen up to the mid-chest and down to the groins is prepped and draped. A long 2–0 silk is placed at the xyphoid that can be stretched down to the vulvar commissure to mark the midline. Four points are marked on the superior and inferior lines at the lateral edge of the rectus. Temporary sutures are placed at each of these points. One-half percent lidocaine with epinephrine 1:200,000 is injected along the planned lines of skin resection. The umbilicus is incised down to the fascial level. This is facilitated by placing single hooks at the 12 o'clock and 6 o'clock positions on the umbilicus, upward retraction, and incision with an 11-blade perpendicular to the stalk of the umbilicus on each side of the umbilicus. The skin hooks are then repositioned to the 3 o'clock and 9 o'clock positions and retracted upward and the incision is completed across the superior and inferior edges of the umbilicus. The dissection down to the fascia is completed with Metzenbaum scissors. The low transverse incision is made down to the muscle fascia. Superficial inferior epigastric vessels are controlled and divided. A low midline cut is made from the previously incised umbilicus to the lower incision. Each hemi flap is elevated to the upper incision line (Fig. 8.4). Rectus perforators are double hemoclipped and divided. It is important to control these perforators to avoid troublesome bleeding or rectus sheath hematoma. Undermining is continued at the level above the muscular fascia to the costal margins and xyphoid. Large perforating vessels along the anterior axillary line are identified and maintained as much as possible.

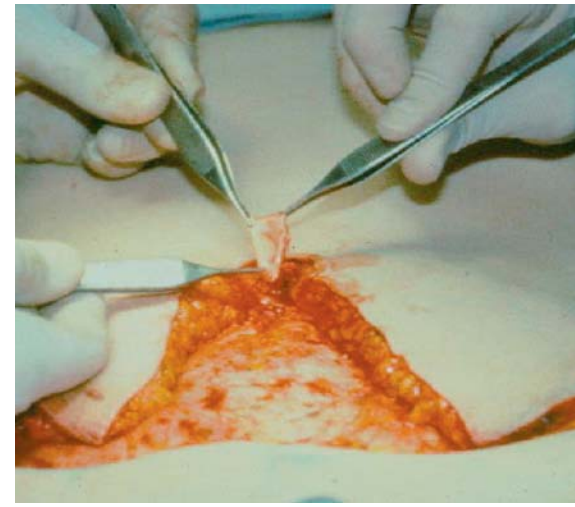

Fig. 8.4. Low midline incision separating the hemi-flaps

Tightening of the abdominal wall is planned and completed before skin resection. Diastasis rectus is repaired (Fig. 8.5). The anterior rectus sheath at the medial edges of the rectus muscle is plicated with a running double stranded O-nylon effectively repairing the diastasis (Fig. 8.6). Care is taken to avoid strangulation of the umbilical stock as it protrudes from this repair. Further tightening and shaping of the abdominal wall is provided by external oblique advancement "the internal corset" as described by Psillakis [6]. The medial edge of the external oblique fascia lateral to the rectus abdominis muscle is incised with the upper limbs gently curving laterally and lower limbs gently curving me-

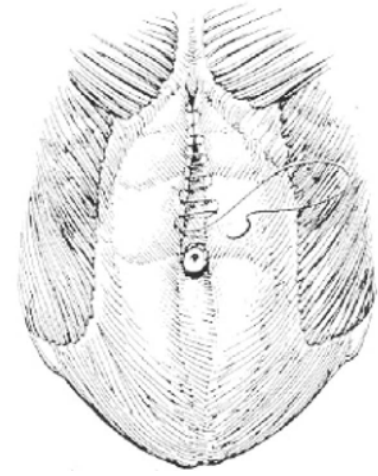

Fig. 8.5. Approximation of anterior rectus sheath at medial edge of rectus muscle to repair diastasis recti

Fig. 8.6. Intraoperative photograph of diastasis recti repair

dially (Figs. 8.7, 8.8). This aponeurosis and the external oblique muscle are elevated from the internal oblique fascia and muscle laterally to the anterior axillary line. The contralateral external oblique fascia and muscle are similarly elevated. Allis clamps are placed on the edges of the external oblique aponeurosis. Medial traction is applied until the desired tightening of the abdominal wall and waist shape are obtained (Fig. 8.8). The new position of the external oblique aponeurosis is marked with methylene blue. Figure of eight stitches of O-prolene are placed to secure the advanced fascial edges. This is followed by a running double strand O-nylon. Tightening of the abdominal wall improves abdominal protrusion and shapes the sides of the abdomen in the frontal view (Fig. 8.7). External oblique advancement is particularly nice for the long waisted or vertically long abdomen with relatively thin subcutaneous fat pad.

Resection of the abdominoplasty flap is done after the abdominal tightening. The superior skin edges are pulled down over the inferior edge and marked to remove redundant skin (Fig. 8.9). This should correspond to the superior key stitches placed earlier. The skin flap is resected and hemostasis of edges obtained (Fig. 8.10). If necessary, lipectomy is performed now. Direct lipectomy is done deep to the Scarpa's fascia in the central abdomen. Careful suction assisted lipectomy is done in the superficial fat pad above the Scarpa's fascia if necessary but crosshatching is avoided. The lateral apices of the wound may require suction assisted lipectomy or direct lipectomy to provide a smooth contour in this region where dog-ears typically occur [7]. Suction assisted lipectomy may be done safely no more than 5 – 10 cm from the edges of undermining or vigorously in no more than one of the three adjacent regions (lateral costal, flank, or hip) [8]. Selective defatting in the supraumbilical region to create a midline depression produces a desirable medial sulcus and accentuates the medial rectus border [6]. Selective defatting laterally helps to accentuate the lateral rectus edges.

The lengthened umbilical stock is dealt with by plicating the umbilicus to the abdominal wall; 3-O nylon dermal to fascial sutures is placed every 120 degrees around the umbilicus. This plication helps to provide a desirable periumbilical depression. With the skin edges

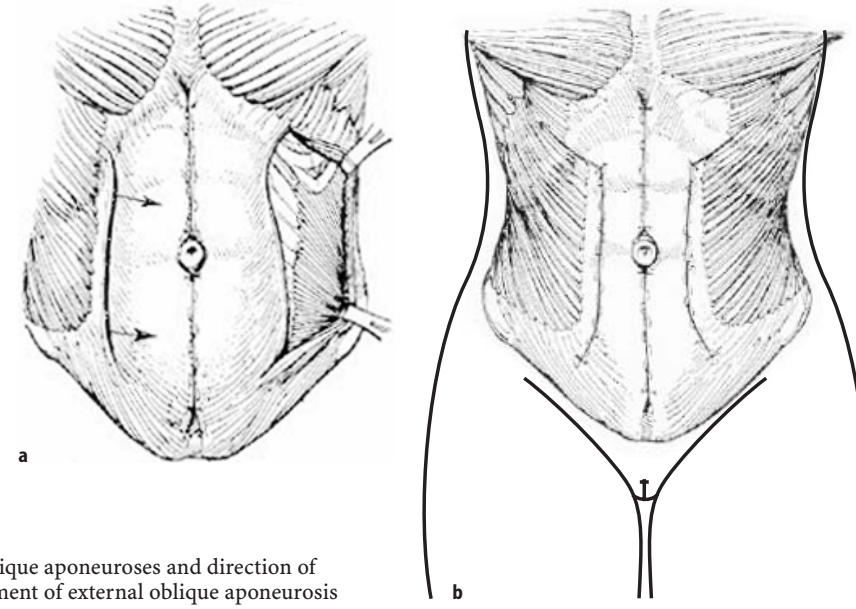

Fig. 8.7. a Incision of external oblique aponeuroses and direction of advancement. **b** Medial advancement of external oblique aponeurosis

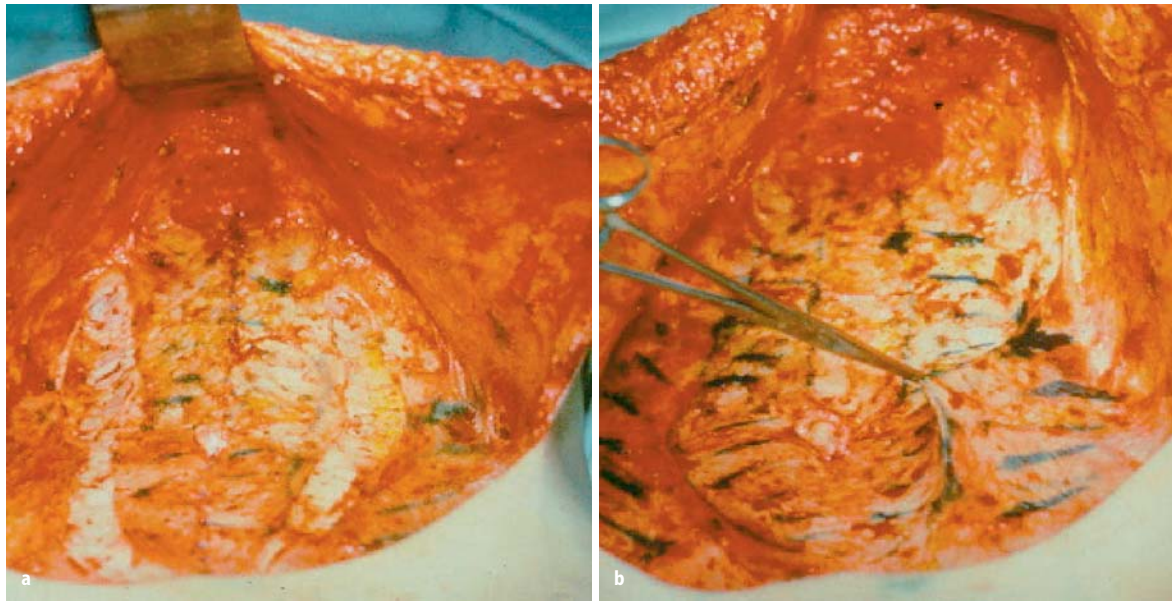

Fig. 8.8. a Intraoperative photograph of incision of external oblique aponeurosis. **b** Intraoperative photograph of advancement of external oblique aponeurosis

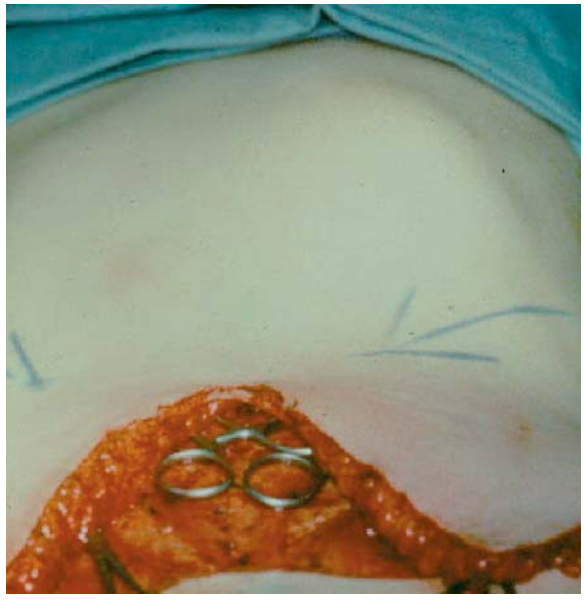

Fig. 8.9. The superior skin flap is pulled down and excised at the level of the inferior skin edge

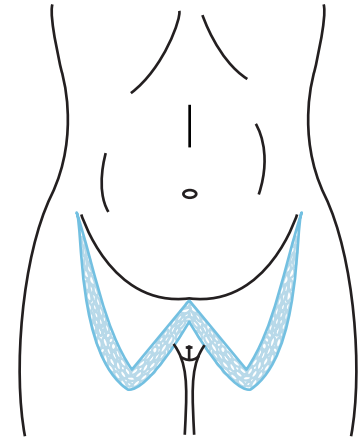

Fig. 8.10. Downward traction on superior skin flap

temporarily opposed with staples, the new skin site of the umbilicus is marked in the midline at least 10 cm away from the skin edge but overlying the plicated umbilicus. A chevron incision, slightly wider than the diameter of the umbilicus, is made in the skin (Fig. 8.11). Selective defatting provides a natural periumbilical depression with mild hooding superiorly. The tip of the chevron is inset into an incision at the 6 o'clock radian of the umbilicus to break up circumferential cicatrice and provide a natural form of the inferior edge of the umbilicus (Fig. 8.11). A technical maneuver to facilitate exteriorizing the umbilicus is to place three triangulating 3-O nylon sutures into the skin edges of the umbilicus and pass through the new skin site to be sutured to the new umbilical site skin edges after the abdominal flaps are approximated. Further 5-O nylon sutures are placed in the inset umbilicus to prevent dehiscence of the umbilicus away from the skin edge. Two flat multiperforated drains are placed beneath the abdominal flap exiting in the pubic skin. The superior and inferior abdominal flap edges are approximated from lateral to medial to decrease dog-ear formation. Scarpas fascia is approximated. Absorbable monofilament 3-O sutures are placed in the deep dermis and a fine skin closure is

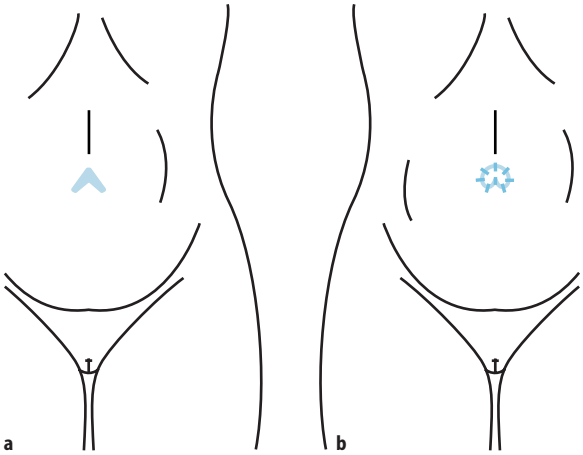

Fig. 8.11. a Umbilicoplasty. A chevron incision is made at the new skin site for the umbilicus. **b** The tip of the chevron is inset into the umbilicus

done. The umbilicus is packed with Xeroform gauze. Xeroform strips, ABDs and a crisscrossed splinting tape dressing are placed followed by an elastic girdle.

8.7 Postoperative Care

The patient is transferred to a bed maintaining a flexed position with the knees elevated. Fluid replacement is administered as necessary. Perioperative prophylactic antibiotics are continued. The patient is mobilized to ambulation as early as possible and until that time compression stockings are continued. Coughing and deep breathing precautions are advised. Liquid diet is begun then advanced as soon as GI functioning is evident. The Jackson-Pratt drains are left in place until less than 30 cc of drainage per 24 h and there is no evidence of fluid collection. The drains are usually left in between 5 and 7 days. The patient is encouraged to stand erect within 1 week. The elastic garment is worn for 2 weeks (Figs. 8.12, 8.13).

8.8 Complications

The most frequent complication of the standard abdominoplasty is the formation of serosanguineous collections. This is mainly a direct consequence of the extensive undermining that occurs during the operation. Adequate placement of drains and leaving them in place until the drainage decreases to less than 30 cc/day is recommended. Elastic compression garments and fibrin glue have also been used to prevent this problem. If seromas occur after drain removal, careful needle aspiration may be a necessary alternative to the opening and placing of another drain. Other potential complications seen with this procedure are cellulitis, wound infection, widened scars, keloid formation, suture reactions, partial skin loss, wound dehiscence, contour irregularities, pulmonary complications, and pulmonary embolism. Infection rates vary from 1 to 2 % in most series but may be increased when there is immune compromise such as in the patient with diabetes mellitus.

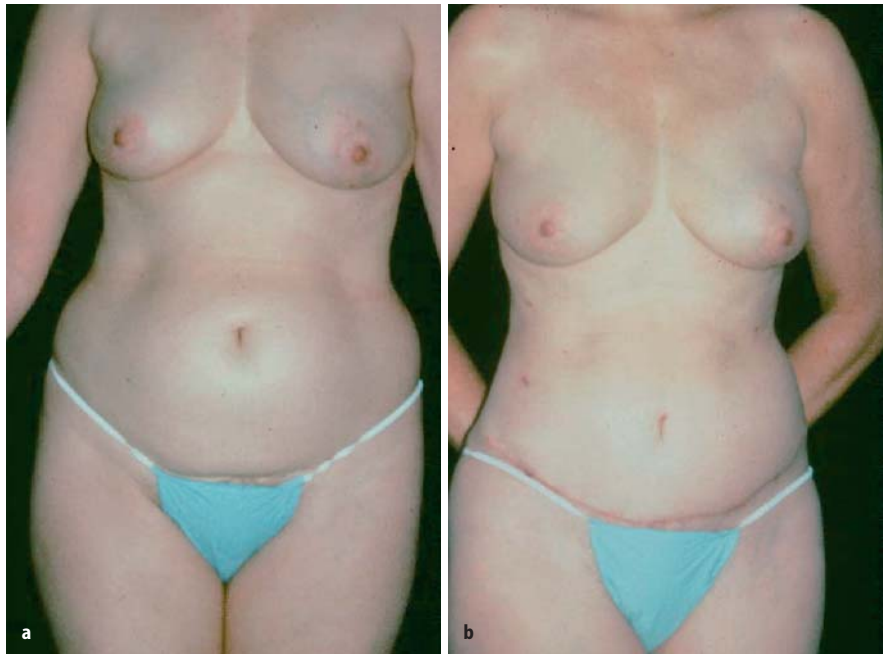

Fig. 8.12. a Preoperative frontal view; **b** postoperative frontal view

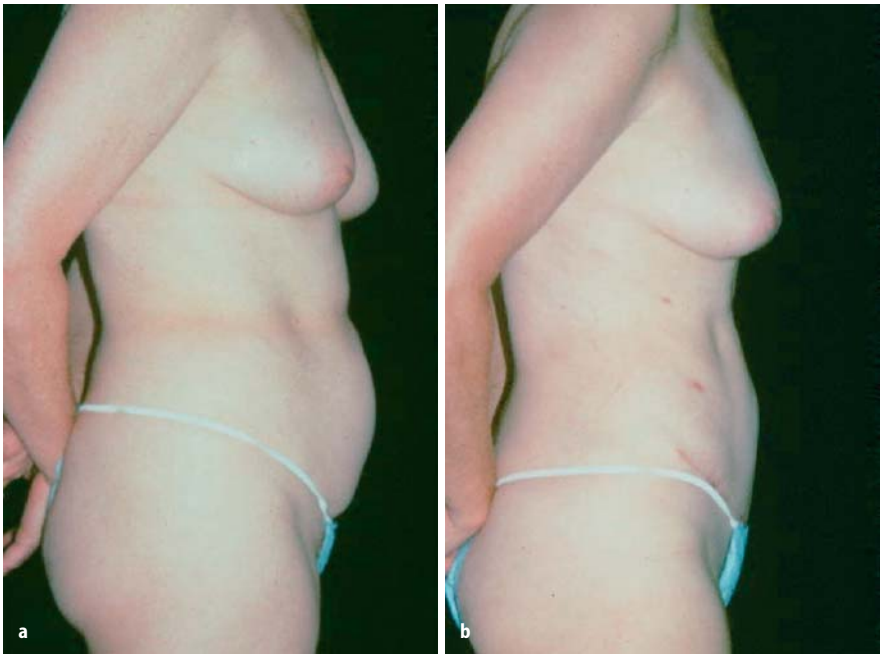

Fig. 8.13. a Reoperative lateral view; **b** postoperative lateral view

Widened scars are directly proportionate to the tension applied on the wound. Keloids may be anticipated in some types of highly pigmented skin. Keloid formation may be decreased by a gentle handling of the skin edges. Erythematous raised hypertrophic scars may be improved with laser therapy. Cortisone injections may be helpful in the more problematic scars.

Areas of partial skin loss and wound dehiscence may occur as a result of impairment of blood supply to the anterior abdominal skin. This is noted at a higher rate in patients who are smokers and diabetics. Typically, the management of the skin necrosis is managed conservatively until the blood supply to the abdominal skin flaps stabilizes and then a revision of either excision and reclosure or scar revision is done.

Pulmonary complications are the most worrisome sequelae of this operation. Tightening of individual components of the abdominal wall compresses the abdominal cavity and may limit diaphragmatic excursion particularly in the patient who has increased intra-abdominal fat.

Pulmonary embolism is a rare but life threatening complication of abdominoplasty. A high level of suspicion should be maintained with any patient who has pulmonary compromise or symptoms of shortness of breath or chest pain in the postoperative period. Diagnosis of a pulmonary embolism is facilitated by the gold standard of pulmonary angiogram or more recently with spiral CT scans. Reported documentation is obtained by lower extremity ultrasound studies. Evaluation and treatment of this potential complication should be aggressively pursued. The prevention of deep venous thrombosis and pulmonary embolism employs heparin 5,000 units subcutaneous preoperatively as well as the use of pneumatic compression devices and early mobilization [9].

Pulmonary insufficiency as a result of tightening of the abdominal wall is a recognized complication of full abdominoplasty. It is the practice in patients with a high risk for pulmonary complications to recommend a more limited operation or consider other options.

8.9 Abdominal Scars

The presence of abdominal scars necessitates careful design of the skin incisions and rethinking of the choice of operative procedure. Infraumbilical scars such as those resulting from appendectomy, herniorrhaphy, hysterectomy, cesarean section, endoscopy portals, or colectomy incisions are usually resected with the dermatolipectomy specimen. Supraumbilical incisions such as subcostal incisions for cholecystectomy, chevron type incisions and Mercedes type incisions pose a greater risk for superior skin flap survival. In these cases a limited skin undermining should be chosen to preserve adequate perforating vessels to the skin flap below the transverse incisions.

The presence of a longitudinal midline scar and low transverse scar may allow resection of the skin in a subcutaneous flap in the vertical and horizontal dimensions but care should be taken not to overresect in these regions as closure may be difficult.

8.10 Combining Standard Abdominoplasty with Other Intra-abdominal Procedures

It is often desirable for female patients to combine abdominoplasty with an abdominal hysterectomy. A significant increase of complications with combined procedures has not been found; however, the literature indicates some slight increase in wound infections. This potential should be discussed with the patient.

8.11 Conclusions

Standard abdominoplasty is selected for the patient with excessive, loose, sagging, abdominal skin, lax abdominal muscular fascial wall and/or diastasis recti. Preoperative evaluation allows for appropriate selection of the patient that may require this procedure. Preoperative skin markings in the upright position facilitate an aesthetic result and symmetrical skin resection. The basic abdominoplasty follows a routine procedure: skin undermining, abdominal wall plication, excess skin resection, lipectomy, umbilicoplasty, and final closure with resection of dog-ears. It is necessary that the skin flap blood supply is preserved as described to prevent skin flap necrosis. Postoperative care is aimed at preventing seroma accumulation.

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9 Personal Approach to Aesthetic Abdominal Deformities

Ivo Pitanguy, Henrique N. Radwanski

9.1 Introduction

The abdomen plays a leading role in the aesthetic image of the upright human body, and is of prime importance in defining the overall contour of the individual. Slimmer forms have substituted the voluptuous figures that were idealized by artists in the past. Today's fashion trends and outdoor activities promote body-revealing attire as never before, and this is especially true in countries with a warmer climate and an aesthetically aware society [1].

Plastic aesthetic surgeons must strive to understand the motivation of patients who present themselves wanting contour alterations of the abdomen. Opposing factors such as sedentary lifestyle, weight gain, pregnancy and the inevitable aging process contrast with the lean and athletic model, and this becomes the source of personal frustration and lower self-esteem. The abdomen is usually seen as central to defining the younger and more vital physique. The desire for surgical treatment of these deformities should be evaluated within the context of what surgery may achieve to bestow a physical form that approximates the individual with his or her ideal self-image [2].

The form of the abdomen is defined by the skeletal structure, as well as the quantity and distribution of fat, the appearance and condition of the skin, the tonus of the aponeurotic and muscular system, and the protrusion of the intra-abdominal organs. Each of these components constitutes an independent variable within the diagnosis of deformity of the abdominal wall, and will determine the type of treatment indicated for the patient.

Three large muscles (the external oblique, the internal oblique and the transversus abdominis) are found on each side of the abdominal wall, which is reinforced at the mid-line by the rectus and pyramidalis muscles. This muscular "shield" is vital for maintaining posture, locomotion and intestinal functions, constituting the primary elements in establishing the tone of the abdominal wall.

Abdominal alterations may be summarized as: cutaneous (redundancies, stretch marks, scars, flaccidity and retractions); accumulation of subcutaneous tissue (lipodystrophy); and those affecting the muscular-aponeurotic system (diastasis, hernia, eventration and convexity). Procedures have, therefore, been described to correct the integument (skin and loose subcutaneous cellular tissue), the aponeurosis and the muscle structure. The ultimate goal of surgery is to achieve an aesthetic contour, with acceptable scars, and the return of full function of the abdominal girdle [3, 4].

A personal approach to abdominal deformities was described in 1967, where attention to both function and aesthetics was emphasized [5]. The functional aspect of abdominoplasties was deemed to be especially pertinent in the older, overweight, multiparous woman. The reinforcement of the abdominal wall, as proposed, was done by the plication of the aponeurosis from top to bottom, without opening of the fascia. A pleasing curvature was given to the waist, not by pulling on the skin, but by tension on the aponeurosis and the muscles.

9.2 Classification

In general terms, the human form may be classified into different somatotypes: mesomorphic, ectomorphic and endomorphic, representing the various body shapes. Mesomorphic individuals have a more solid, stronger appearance. Ectomorphs are characterized by their length and fragility, with minimal development of muscular and fatty tissue. Endomorphs feature excessive fat, a protuberant abdomen and short limbs. There is naturally a high level of variability among the three types.

On the other hand, the patient that presents with an aesthetic complaint regarding the abdomen may have his or her abdomen described as either pendulous, globous or flaccid. The pendulous type presents an accumulation of fat in the inferior abdomen and around the umbilicus, with the skin folding back over the pubis due to excess weight. The globous abdomen is rounded with generalized distention and a variable quantity of fat, with or without flaccidity of the aponeurosis and muscle system. The flaccid abdomen features skin that is loose, often with stretch marks or striae.

Table 9.1. Pitanguy's classification of aesthetic abdominal deformities

Type	Clinical presentation	Suggested technique
I	Abdominal lipodystrophy without skin flaccidity; absence of diastasis or hernia	Liposuction
II	Moderate abdominal lipodystrophy with diastasis	Mini-abdominoplasty or endoscopic abdominoplasty
III	Accentuated abdominal lipodystrophy with cutaneous flaccidity and excess; presence of diastasis; with or without associated scar	Standard abdominoplasty
IV	Skin flaccidity and/or lipodystrophy, with diastasis or eventration; associated scar	Atypical approach
O	Marked generalized abdominal lipodystrophy with absence of excess skin	These patients are not ideal candidates for abdominoplasty, and should be prepared for surgery by strict clinical treatment to lose weight

The author has proposed a classification of aesthetic abdominal deformities [6–8]. Aesthetic defects are those that modify the outline of the body, due mainly to the flaccidity of the abdominal wall, accumulation of fat, and weakening of the aponeurosis and muscle system. This classification has proven useful in selecting the most appropriate surgical procedure for each case, ensuring treatment with consistently satisfactory results, both aesthetic and functional (Table 9.1).

9.3 Preoperative Planning

The abdomen should be evaluated in itself and also in relation to the breasts and the trochanteric region, allowing the surgeon to decide whether or not an associated surgical procedure is indicated, in order achieve a more harmonious overall result [9]. The patient is examined standing up, sitting, and lying down. Careful palpation should inspect for hidden hernias and muscle weakness. The surgeon should grasp the infraumbilical flap and pull downwards, so as to estimate the final tension that will be placed on the flap.

The patient's overall health and psychological status should be evaluated as for any aesthetic procedure. Appropriate laboratory examinations are routine, and specific assessments are requested case by case. Weight loss is part of the preoperative preparation for a considerable number of patients presenting with contour alterations of the abdomen, and the collaboration of a multidisciplinary team should be considered, which may include the endocrinologist and a nutritionist. Maceration, intertrigo and dermatitis are found in some patients, secondary to constant moisture and rubbing of skin folds caused by skin redundancy, particularly in patients with apron-like abdominal flaps. Any dermatological condition must be treated accordingly.

Aesthetic body contour deformities may be restricted to the abdomen; yet frequently these alterations affect two or more distinct areas, demanding more complex surgical planning. Multiple or severe alterations are seen especially in patients who have undergone dramatic weight loss, and who thus will require a multistage program [10]. Not infrequently, these patients present with a variety of complaints, and the surgeon must decide and plan for two or more procedures accordingly. There are, of course, many benefits for the patient if associated procedures can be performed during one single operation and hospitalization [11–13].

The approach to multiple contour deformities in the patient who has suffered a great loss of weight is personal. Procedures such as mammaplasty, abdominoplasty, dermolipectomy and liposuction can be indicated, in various combinations [14–21]. More important than the technical procedure, however, is a correct diagnosis and careful surgical planning.

In associating procedures, the extent of the operation and surgical trauma, as well as the length of anesthesia, must not be greatly increased. Blood loss should be anticipated, and whenever indicated, autologous blood transfusion is planned beforehand. Combining procedures also demands that the surgical team be appropriately trained. The surgeon is seen as the leader of an orchestrated group, and the members are well prepared for each stage. The sequence of the operation should be logical and planned in such a manner that part of the team is closing one region while the surgeon undertakes the second or third procedure, leaving ample room for each member to work comfortably. One should not attempt newer approaches when associating techniques, as this may be time-consuming. We also prefer not to carry out combined plastic surgery procedures in conjunction with other specialties.

Finally, the surgeon who agrees to operate on the patient's abdominal deformity should openly enquire into the patient's expectations and motivations, and the limitations of the surgical procedure should be explained, especially regarding the placement of final scars. Caution should be taken when the patient de-

mands an incision that will be covered only by a certain type of bathing suit, because fashion trends will pass, while the scar is permanent.

9.4 Surgical Technique

9.4.1 Abdominoplasty

The principles of the author's technique in abdominoplasty have been adhered to since the first publications. It is true that the placement of scars has changed according to the model of beach attires, and currently the incision is placed immediately above the pubic area with a horizontal lateral extension, curving upwards. There may be certain variability, dictated by the patient's preference for bathing suits. A long suture is useful to check for symmetry (Fig. 9.1).

Following the lower incision, the fatty layer above the pubis is beveled, assuring a certain amount of adipose tissue, preventing the displeasing depression over the midline that sometimes occurs. Knife dissection proceeds over the muscle fascia until the umbilicus is reached. A circular incision is done around the umbilicus, and the lower abdominal flap is divided. Sharp undermining reaches the costal margins, but the dissection should be limited laterally.

Muscle diastases are repaired through plication of the rectus abdominis aponeurosis, without opening the muscle fascia, as had been previously done. This reinforcement of the abdominal wall, which was first proposed by the authors [5], begins at the xyphoid process to correct epigastric protrusion and extends down to the pubis. Strong non-absorbable sutures are placed in an "X" fashion, inverting the knot, tightening the aponeurosis of the rectus abdominis muscle (Fig. 9.2).

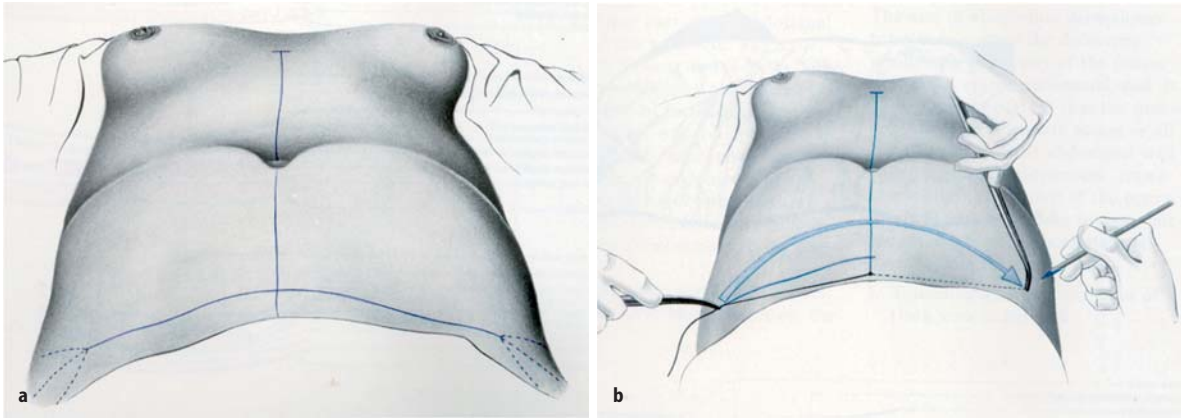


Fig. 9.1. a Drawing shows the various incisions that may be used, as long as they are kept hidden by bathing trunks. **b** A long suture, placed at the midline, is useful to check for symmetry

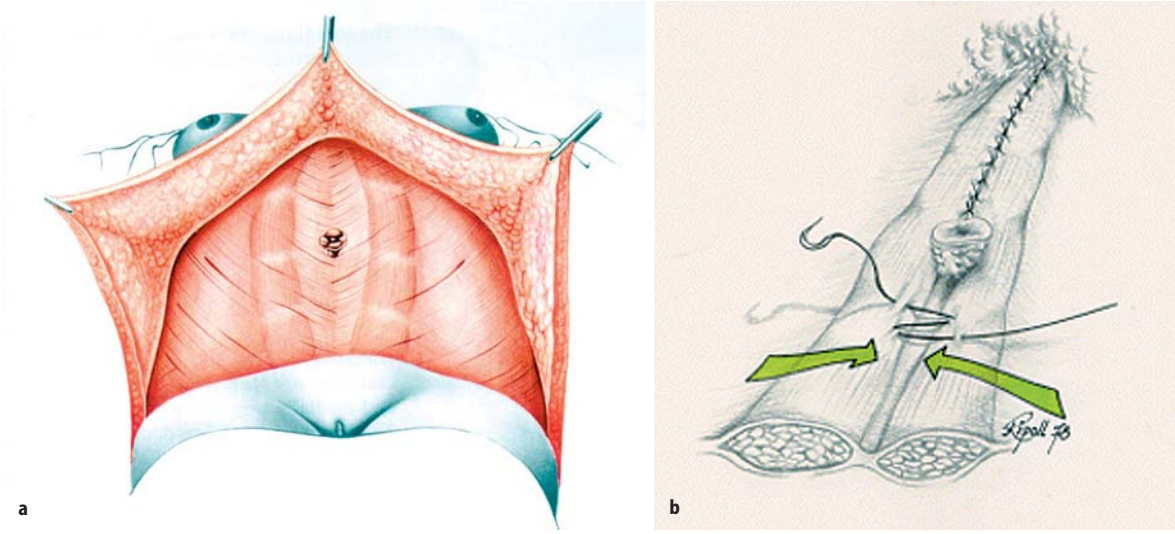
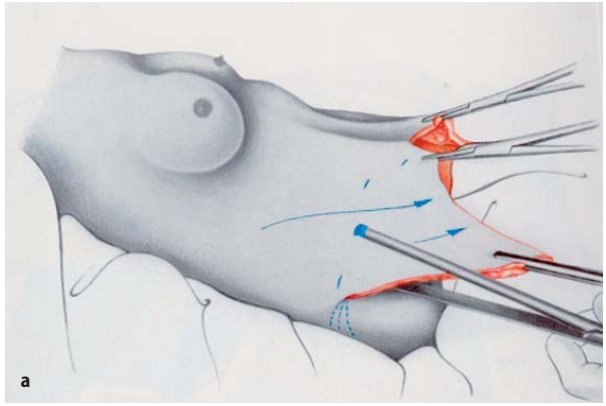


Fig. 9.2. a Plication of the rectus abdominis muscle, as described initially by the senior author, extends from the xyphoid to the pubis, without opening of the aponeurosis. **b** Detail of inverted sutures



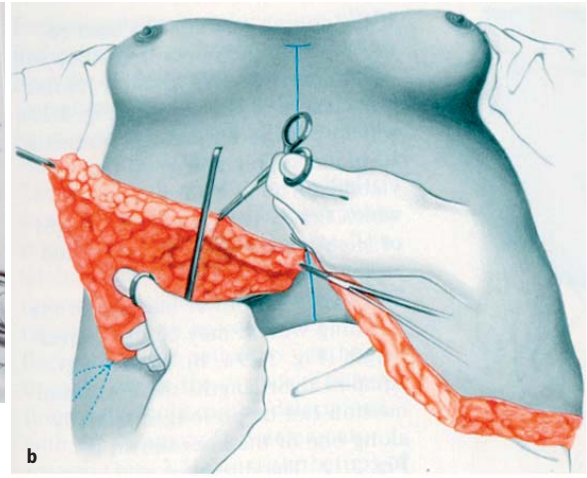


Fig. 9.3. a, b The patient is flexed prior to demarcation of excess tissue. A temporary suture is placed in the midline to equally distribute and fix the flaps, and a long Pitanguy flap demarcator is used to estimate amount of excess tissue

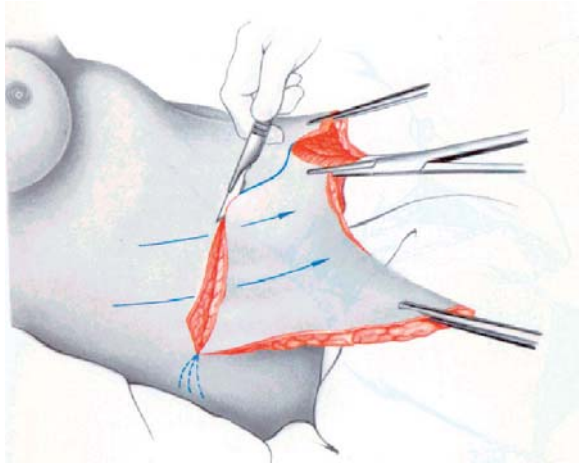


Fig. 9.4. After demarcation each flap is incised, beveling the adipose tissue

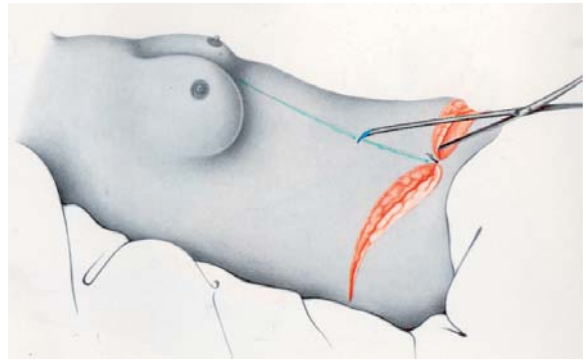


Fig. 9.5. The flap demarcator is helpful in the demarcation of the new position of the umbilicus. The incision is transverse, in a straight line without removal of tissue, which becomes triangular by the traction of the flaps

When the pedicle of the umbilicus is very long, it may be shortened with sutures, anchoring it firmly to the abdominal wall. This should be done without exaggeration, especially in patients with a thick panniculus, so as to avoid excessive traction.

The table is now elevated, raising the patient's trunk to an angle of 15°, and a temporary suture at the midline fixes the flap. The assistant pulls each flap downwards and towards the midline. A long Pitanguy flap demarcator is useful to estimate the precise amount of excess tissue, and this is marked (Fig. 9.3). The same procedure is done to the opposite side, and both flaps are checked for symmetry, before final dermolipectomy (Fig. 9.4).

The umbilicus should be exteriorized at a level corresponding to its natural position, without traction to avoid displacement. The same demarcator checks for the correct position of the umbilicus on the exterior surface of the abdominal wall (Fig. 9.5). Our preferred method of creating the neo-umbilicus has been through a transverse, or semicircular, incision measuring approximately 2 cm, which is done at the demarcated point. There is thus no resection of skin. It will be noticed that this straight line becomes a natural triangle when the flap is positioned. A resection of subcutaneous tissue is removed below this incision in a "cork-like" fashion, so as to cause a smooth periumbilicus depression (Fig. 9.6). The umbilicus is then brought to the surface of the flap, using long sutures (Fig. 9.7).

Before final sutures, suction-assisted lipectomy is performed, in areas not undermined. Closure is done by planes, bringing the flaps inwards, so as to avoid "dog-ears" and not elongate the final scar (Fig. 9.8).

Atypical approaches to the abdomen are dictated mainly by preexisting scars. Vertical incisions below the umbilicus allow the surgeon to compensate the flaps medially, reducing the lateral extension of the lower horizontal scar. On the other hand, a vertical scar

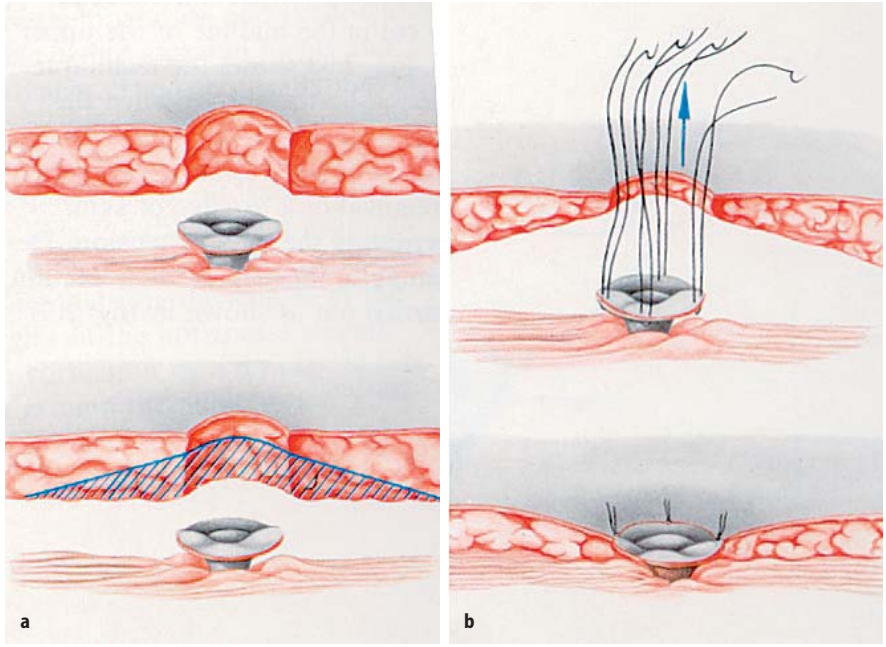


Fig. 9.6. a, b A cone of subcutaneous tissue is resected, allowing for the exteriorization of the umbilicus and its pedicle

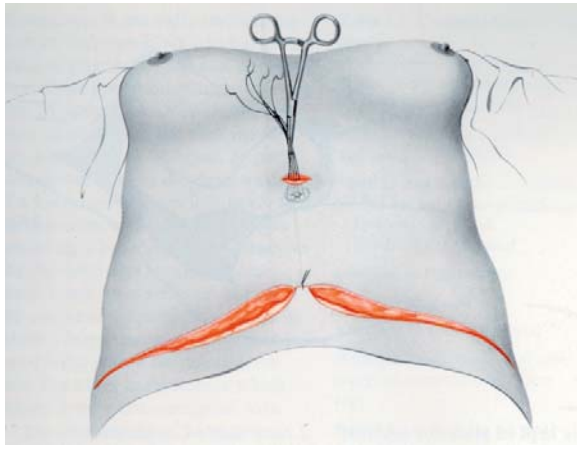


Fig. 9.7. The umbilicus is pulled out and then is sutured in its place

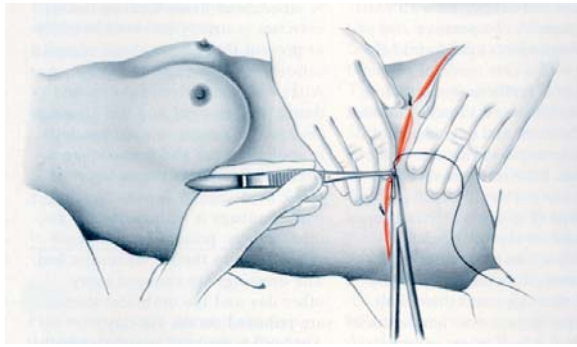


Fig. 9.8. Final sutures are done by planes, with the assistant pulling the flap inwards so as to decrease lateral extension of the final scars

that extends from the upper to the lower abdomen may allow the surgeon to forego a horizontal incision altogether, permitting the correction of redundant skin by bringing the undermined flaps towards the midline (Cases 1 – 5: Figs. 9.9 – 9.13).

Hernias or eventrations may preclude primary closure of the aponeurosis, and an aloplastic mesh will become essential to permit closure of the defect and assure equal tonus of the entire abdominal wall [22] (Cases 6 – 9: Figs. 9.14 – 9.17).

Serosanguineous collections are one of the most frequent complications following abdominoplasties, yet in our experience the rate of collections has been low. A few maneuvers have been adopted and have proven useful in preventing collections. These include the covering of all tissues with moist sterile towels to avoid desiccation during surgery, and rigorous hemostasis with the routine placement of drains.

A plaster shield, molded over a thick, soft dressing, has been adopted as part of our routine [23]. This becomes, as it were, a custom-designed anterior abdominal plate, covering all undermined tissues, and is maintained for the first two postoperative days. A 2-kg weight is placed to assure an even and firm pressure, guaranteeing adhesion of the dissected flap (Fig. 9.18). This diminishes the risk of hematoma and seroma, and has been noted to decrease patient discomfort during the first 48 postoperative hours.

Fig. 9.9a, b. Case 1. **a** Preoperative 31-year-old woman with lower abdominal flaccidity and diastasis (type II deformity). **b** Two years postoperatively following mini-abdominoplasty

Fig. 9.10a, b. Case 2. **a** Preoperative 45-year-old woman with abdominal flaccidity, lipodystrophy, and rectus diastasis (type III deformity). **b** Two years postoperatively following standard abdominoplasty

Fig. 9.11a, b. Case 3. **a** Preoperative 46-year-old woman with abdominal flaccidity, lipodystrophy, and rectus diastasis (type III deformity). **b** Two years postoperatively following standard abdominoplasty

Fig. 9.12a–d. Case 4. **a, b** Preoperative 36-year-old woman with abdominal flaccidity (type III deformity) and breast ptosis.

Fig. 9.12c, d. Two years postoperatively following standard abdominoplasty, placing the incision so as to respect the lower type of bathing trunks and mastopexy procedure

Fig. 9.13a–d. Case 5. **a, b** Preoperative 51-year-old man with abdominal deformity type III following weight loss of 45 kg.

Fig. 9.13c, d. Two years postoperatively after standard abdominoplasty with suction-assisted lipectomy of the anterior chest for correction of pseudogynecomastia

Fig. 9.14a, b. Case 6. **a** Preoperative 29-year-old woman with an unsightly longitudinal scar due to a previous exploratory laparotomy (type IV deformity). **b** One year postoperatively after vertical abdominoplasty with muscle reinforcement

Fig. 9.15a, b. Case 7. **a** Preoperative 35-year-old woman presented with an incisional hernia in the lower abdomen (type IV deformity) and breast ptosis. **b** Four years postoperatively following standard abdominoplasty without mesh reinforcement, together with a mastopexy

Fig. 9.16a–c. Case 8. **a** Preoperative 35-year-old man with an incisional hernia after an exploratory laparotomy (type IV deformity). **b** Reconstruction of the abdominal wall was performed after tissue expansion with two "croissant" shape expanders through an atypical abdominoplasty with mesh reinforcement. **c** Two years postoperatively

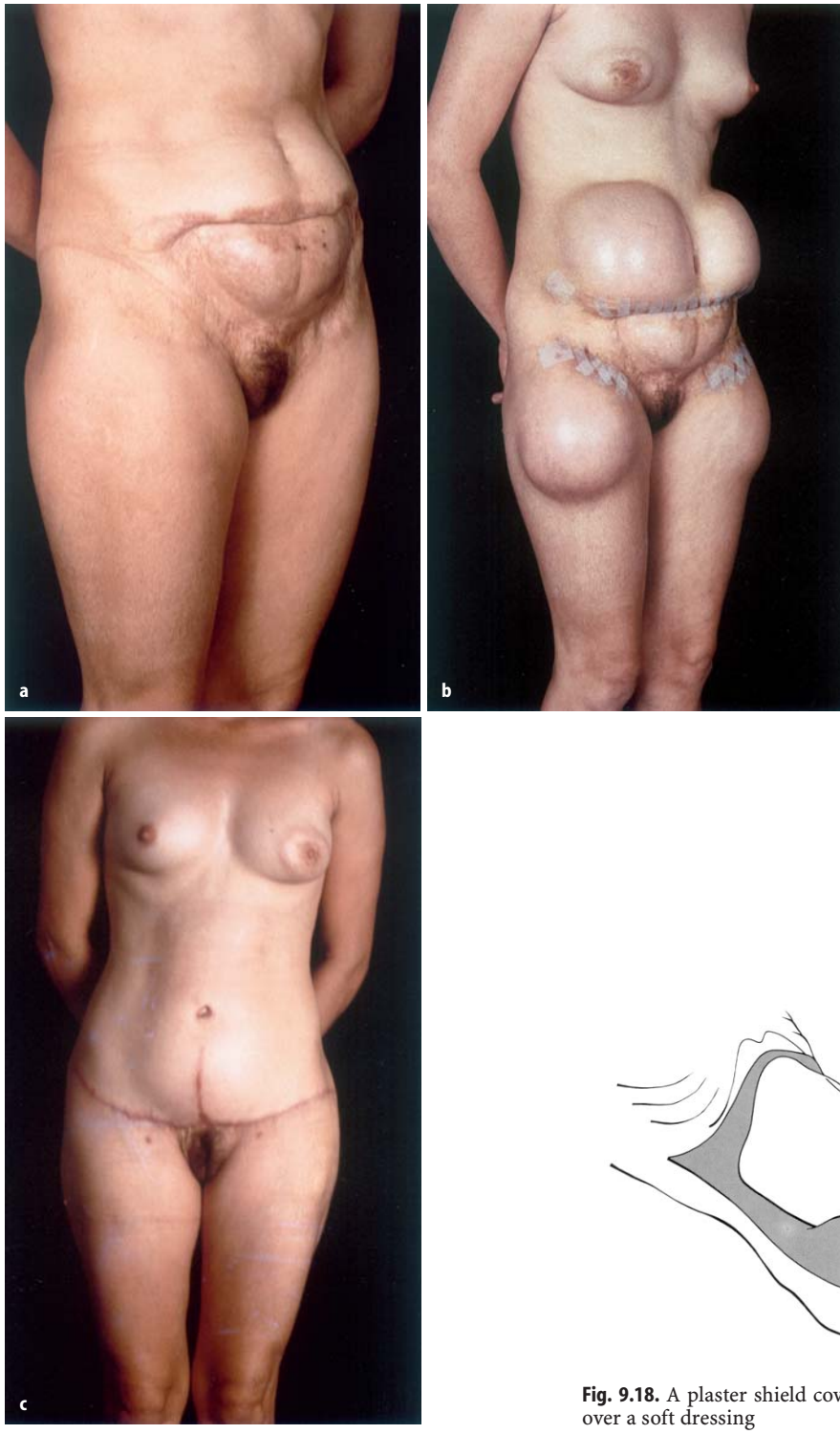


Fig. 9.17a–c. Case 9. **a** Preoperative 46-year-old woman with an incisional hernia in the lower abdomen (type IV deformity) and breast ptosis. **b** Atypical abdominoplasty with mesh reinforcement was performed after tissue expansion in the upper abdomen and superior thighs. **c** Two years postoperatively

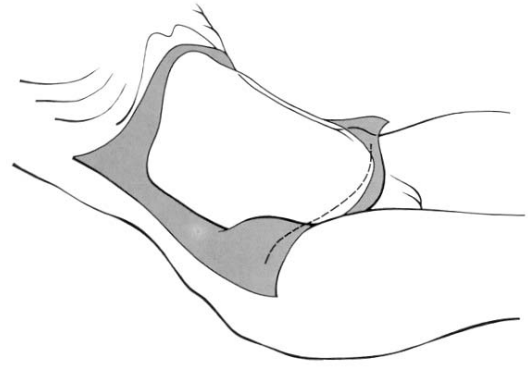


Fig. 9.18. A plaster shield covers all the dissected flap, placed over a soft dressing

9.5 Liposuction (Cases 10, 11: Figs. 9.19, 9.20)

An important contribution to contouring of the trunk was the introduction of suction-assisted lipectomy (SAL) in the late 1970s, which has permitted the removal of fat deposits by means of minimal incisions. Modeling of the abdomen has been considerably improved, either as a single procedure or associated with abdominoplasty, allowing the surgeon to complement a dermolipectomy with liposuction to enhance the waistline.

Suction-assisted lipectomy has also decreased the necessity for extensive undermining, thus contributing to lessening the rate of complications, such as serosanguineous collection and flap ischemia. Liposuction is

Fig. 9.19a, b. Case 10. **a** Preoperative 26-year-old patient with lower abdominal lipodystrophy (type I deformity). **b** Two years postoperatively after liposuction

Fig. 9.20a, b. Case 11. **a** Preoperative 22-year-old patient presented with lower abdominal lipodystrophy (type I deformity). **b** Two years postoperatively following liposuction

frequently done to other anatomical areas in association with abdominoplasty. It should be emphasized that liposuction should be restricted to non-undermined areas. Two primary arterial plexi are responsible for the irrigation of the abdominal wall: a subdermic superficial system and a deeper, more profound musculoaponeurotic system. Many blood vessels form anastamotic connections between the two levels, particularly in the periumbilical region. This vascular anatomy must be respected so as not to risk causing a decrease in vascularization of the abdominal flap.

Acknowledgements. The authors are grateful for the collaboration of Francisco Salgado, MD, and Alan Landecker, MD.

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Abdominoplasty Technique: A Personal Approach 10

Oscar Ramirez, Keith M. Robertson, Anjum Khan

10.1 Introduction

The abdominoplasty procedure needs to be tailored to the trunk anatomy and to the aesthetic goals. Those with a small amount of infraumbilical protuberance without excess skin may be treated with endoscopic muscle plication and abdominal liposuction [1, 2]. An open approach is used when the skin tone is poor. There is a moderate to large amount of excess fat and moderate to severe abdominal wall laxity. Procedures range from a mini-abdominoplasty with inferior translation of the umbilicus with or without muscle plication to the most extensive version with massive dermatolipectomy, plication of the rectus sheath (for the treatment of the muscle diastasis) and transposition of the umbilicus to a new location in the abdominal wall skin [3, 4]. High lateral tension with fascial suspension, advancement of the external oblique fascia and liposuction have been useful additional maneuvers to define the waistline further, especially when dealing with severe abdominal wall deformities [5–7].

All the functional and cosmetic concerns of the abdominal wall may be met by utilizing our comprehensive approach. A significant elevation of the mons pubis and the upper anterolateral thigh occurs with this technique. By restoring appropriate tension to the abdominal musculature, the individual's posture improves and tension is diminished in the lumbar spinal muscles [8].

10.2 Markings

Many of the previously designed abdominoplasty incisions violated the aesthetic units of the thighs or abdomen. They tended to produce "dog-ears", which often needed to be dealt with as a second procedure. The resulting scars are not hidden by the high cut style of bathing suits. The "UM" shape of incision does not have these problems [9]. If a panniculus is present, it is very helpful to have an assistant hold this so that both the surgeon's hands are free for marking. Reference lines are drawn to facilitate symmetry and to appreciate better any excess of tissue on one side versus the other. When significant asymmetry is present, the position of the incision is modified as necessary. The reference lines are: (1) the midline joined to xyphoid, umbilicus and vulvar commissure; (2) lines marked 10 cm on either side of the midline; (3) the outlines of the anterior and posterior silhouettes of the body as we see the patient from the front and from the back; (4) the line that starts in the groin crease and extends in a straight line towards the iliac areas; and (5) a circumferential line at the narrowest part of the waist.

The lower incision of the area of resection is shaped like a U. This is marked first. The pubis is lifted and a horizontal line is marked 7 cm from the anterior vulvar commissure. The ends of this marking are extended lateral to the groin crease while the anterolateral thigh skin is elevated manually. The marking moves towards the waistline. The upper incision is marked from the ends of the U incision. It is shaped like an M. Its central portion usually lies just above the naval. The peaks of the M are usually at the paramedian vertical line or the level of the linea semilunaris. The area of skin to be resected is grasped to confirm that the wound can be closed without excessive tension. The symmetry is observed on the flaps to be closed, not on the tissue being resected. All palpable hernias and the degree of rectus diastasis are marked. Markings are done with the patient naked standing with the feet about 60 cm apart.

10.3 Preoperative Concerns

The main aim of the operation is to obtain a flatter abdomen and a smaller, more defined waistline. Tightening of the abdominal wall causes a significant inward pressure on the abdominal contents. The outward pressure of the bowels may cause pain and ileus. Sometimes this results in suture line dehiscence or vomiting. The Valsalva maneuver will further increase the tension against the line of muscle and skin repair. Increased intra-abdominal pressure pushes the diaphragm upwards and decreases the respiratory functional residual

capacity (FRC), which predisposes to atelectasis. It compresses the vena cava, decreasing the venous return and increasing venous stasis, one of the biggest risk factors for pulmonary embolus and deep venous thrombosis. The preparation consists of a clear liquid diet for 3 days, enemas and laxatives. Oral antibiotics are also administered for 3 days prior to surgery to decrease the amount of intestinal bacterial flora, thus decreasing the production of intestinal gas. To avoid dehydration, plenty of oral fluids and electrolytes are recommended. Chlorpropamide, 10 mg, is taken orally every 6 h for the first 5 days after surgery to decrease production of succus entericus and to stimulate peristalsis. Opioids slow peristalsis and are avoided when possible. As a consequence of using this perioperative plan, we have earlier recovery of bowel function with no cases of postoperative ileus or abdominal distention. The patients have less pain and rarely have deep venous thromboses.

After the surgery, all patients will have difficulty breathing deeply. This is due to pain, muscular tightness and upward pressure on the diaphragm from the compressed intra-abdominal contents. Those who primarily use their abdominal muscles for breathing present a special challenge. They need to strengthen their diaphragms, intercostal muscles and accessory muscles because their abdominal muscles will function poorly for the first few days. In order to train the diaphragm, the patient is given breathing exercises that may be performed under the direction of a respiratory therapist. They are given an abdominal binder to wear preoperatively so that they may practice diaphragmatic breathing.

Smoking compromises the circulation of the raised abdominal wall flap and contributes to the development of skin necrosis. Everyone who has recently smoked including those who have already stopped is prescribed pentoxifylline 400 mg t.i.d. for 6 weeks before surgery. This increases the flexibility of the red blood cell membrane. They are also given bupropion to help them to stop smoking.

10.4 Operative Technique (Fig. 10.1)

Saline with adrenaline (1 : 1,000,000) is infiltrated at the fat/fascia level. The waistline and iliac areas are treated with standard liposuction techniques using cannulas between 3.7 and 6 mm in diameter. The flaps to be advanced inferiorly are suctioned at the intermediate level of the subcutaneous layer in order to protect the vascularity. Suctioning is performed following the orientation of the segmental intercostal blood supply. The new midline above the new umbilicus is the only area that is suctioned more aggressively. This produces the illusion of a more sculpted abdomen. The flap is not suctioned below the level of the new navel since this may damage the blood supply [5, 8]. The lower incision is performed first. The large vessels are suture-ligated and the rest of the dissection is performed with cautery. The flap is raised leaving the fine areolar tissue and their lymphatics over the fascia. This may diminish the rate of seroma formation. Large perforators are suture ligated and divided before they retract into the muscle or the subcutaneous tissue. These large vessels might tend to bleed postoperatively, particularly with coughing or other Valsalva maneuvers. The ensuing hematoma can lead to postoperative pain or seroma. The navel is excised from the surrounding skin and fat. If there is a large amount of extra skin and fat, especially in the supraumbilical portion, the flap is dissected over the costal margins and the xyphoid cartilage. This allows better redraping of the upper abdominal tissues and minimizes folds and skin creases. There are no important perforators in the upper central abdomen, so it is unlikely that dissection and mobilization in this area leads to tissue necrosis.

The upper incision is made after a trial of advancement of the upper flap. Adjustments are made at this point as needed to prevent excessive tension or redundancy. The incision through the cutis is made at right angles to the surface. Then, the blade bevels to lie at 45° to the surface of the flap so the Scarpa's fascia portion of the flap is about 1.5 cm shorter than the skin portion. However, the deeper part tends to retract. Repair of the diastasis is performed by splitting the rectus fascia. The diastasis is noted and an ellipse is marked on the anterior rectus sheath from xyphoid to pubis with the widest portion of the ellipse located 3 cm above the navel. This will ensure that the upper abdomen is tighter and flatter than the lower abdomen. A slight convexity below the umbilicus is a normal feature of the young female abdomen. Overzealous liposuction or too tight a fascial closure also flattens the lower abdomen; the result is a masculine appearance. The anterior rectus fascia is incised along the markings of the ellipse by placing a hemostat deep to the fascia and cutting the fascia over it. All musculocutaneous perforators are suture ligated. The inner margins of the fascial split can be sutured to each other to increase the imbrication and to deepen the naval. The external margins of the split fascia are sutured in the midline with inverted horizontal figure of eight mattress sutures using non-absorbable material, usually 0 to #2 Tevdek (Deknatel DSP, Full River, MA).

To further define the waistline, the external oblique fascia and muscles may be advanced towards the midline. This may be done with the rectus fascia attached also. About 100 cc of 0.25 % bupivacaine with 1 : 100,000 epinephrine is injected just beneath the external fascia of the rectus and the external oblique muscles with

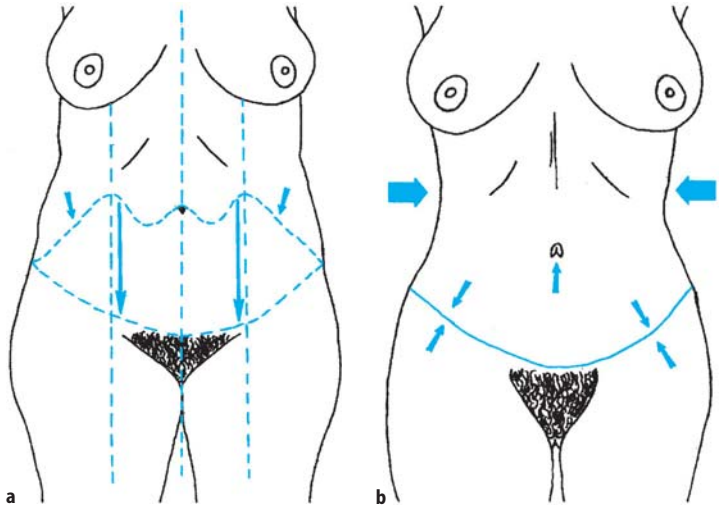
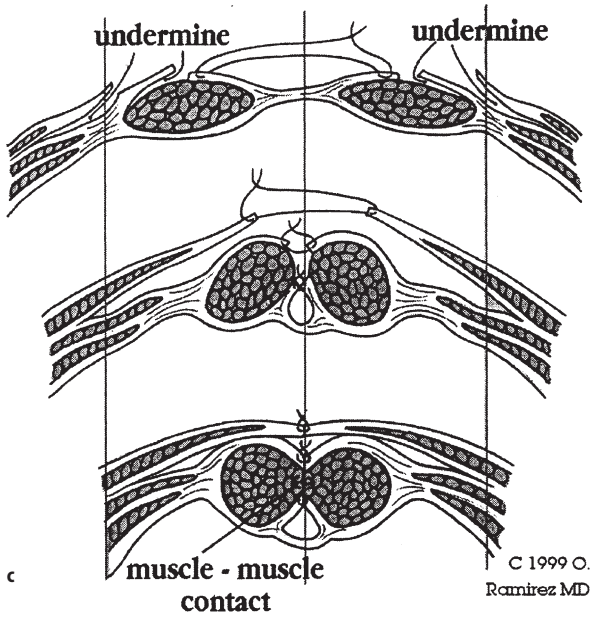


Fig. 10.1. a UM incision is marked. The approximation of the lateral humps relieves the tension from the midline closure. **b** Closure slims the waist. **c** The rectus fascia is sutured to close the diastasis

blunt needles or thin cannulas to anesthetize the regional nerves to the abdominal muscles. The trajectory of the needle or the cannula should be visualized by translucency through the fascia to avoid inadvertent injection into the peritoneum. This local anesthetic injection greatly decreases the patient's need for narcotics for the first postoperative day.

The umbilicus is removed from the abdominal skin with a heart-shaped incision around the navel. Using two permanent sutures, the long umbilical stalk is telescoped from the dermis to the rectus fascia. The new position of the navel on the abdominal skin flap may be located with an umbilical demarcator. A triangular incision is made on the abdominal skin at this point. The incision becomes a heart shape when the skin of the abdominal flap is pulled. A small amount of defatting is performed so the new periumbilical skin will sit more flush with the naval. The navel is inset in two layers us-



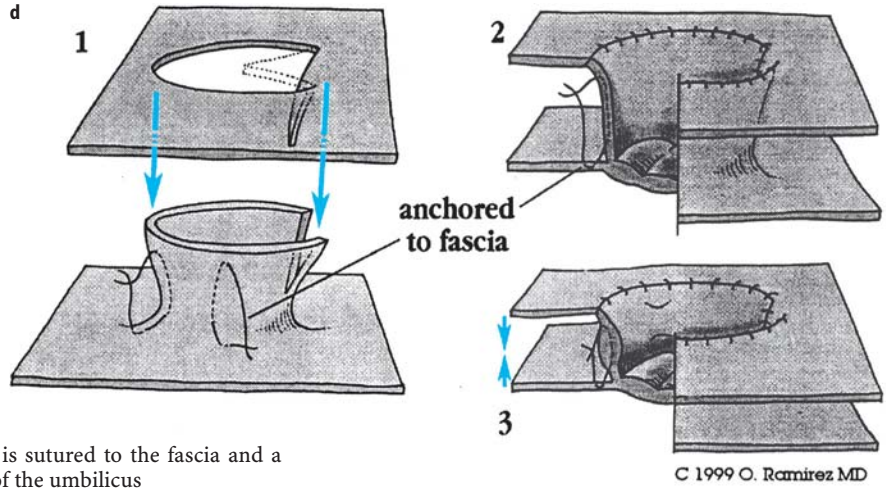


Fig. 10.1 d The umbilical stalk is sutured to the fascia and a V cut from the inferior aspect of the umbilicus

ing 3–0 Nylon. The abdominal flap is closed in three layers: Scarpa's fascia with 2–0, 3–0 Tevdek, deep subdermis layer with 4–0 Prolene and 4–0 subcuticular pull out skin sutures. First, three aligning sutures are applied. The first is applied to the Scarpa's fascia in the midline to centralize the flap. The paramedian sutures are applied while the upper flap is pushed medially. The upper flap has a tendency to drift laterally. They are placed midway between the midline and the end of the incision. The incision is closed starting with the corners. Any redundancy is compensated toward the midline. Thus, there is minimal tension during wound closure at the midline. Two closed system suction drains are left under the flaps with the ends towards the flanks in a criss-cross fashion to avoid kinking of the drains. Topifoam (Lysonic, Inc., Carpenteria, CA) and a tight-fitting abdominal binder are applied.

10.5 Postoperative Management

The patients are given intravenous fluids and antibiotics for the first postoperative day. A clear liquid diet is started the next day and the diet is advanced gradually as tolerated. Supportive stockings and pneumatic boots are used until the patient is walking. A walking frame is used to help mobilize the patient early. Everyone receives chlorpropamide 10 mg q.6 h. orally and a stool softener until regular bowel movements start. The drains are advanced on the fourth postoperative day and removed when the drains are less than 20 cc per drain in 24 h. Oral antibiotics are continued until the drains are removed. A binder is worn for the first 8 weeks. Patients may drive after 4 weeks and perform light exercise at 8 weeks. All restrictions are lifted at 14 weeks.

10.6 Results

Since 1986, over 150 people have had an abdominoplasty performed by the senior author. Over 80% had concurrent muscle repair. No patients in this series were repaired with alloplastic materials. The most common significant complication has been that of infraumbilical skin slough (2.7%). The largest area seen was 10×7 cm. This was in a patient who continued smoking in the perioperative period. This patient was lost to follow-up. Two other patients with smaller areas of necrosis (5×4 cm and 4×3 cm) have had revisions performed.

Less than 7% of patients had seromas requiring repeated aspiration. One patient needed re-excision of a pseudobursa. She also underwent further tightening of the musculature of her lower abdomen. One patient had a drain tract infection treated with drainage and antibiotics. One patient developed an abdominal wall abscess just inferior to her xyphosternum. We believe this was introduced with a liposuction cannula. She was treated with open drainage, antibiotics and dressing changes. Her abdominal flap was readvanced 4 months later with an excellent cosmetic result. One patient developed a deep venous thrombosis in her calf.

No secondary hernias have been seen. Back pain and posture were significantly improved. We have measured the decrease in waist circumference to be from 6–20 cm with an average of 10.5 cm.

10.7 Discussion

Those with small infraumbilical pouches will benefit from liposuction alone or from a mini-abdominoplasty. Those with a pannus, severe muscle laxity or a diastasis have a more severe deformity that requires a more extensive approach. The UM abdominoplasty addresses ptosis of the mons pubis, ptosis of the anterolateral thigh skin, excess abdominal skin, poor abdominal muscle tone and the ill-defined waistline.

The scars are placed so that they do not violate aesthetic units. They are not visible when wearing high cut bathing suits.

The umbilicoplasty method avoids a circular scar that may produce constriction. It anchors the superior part of the flap, decreases the dead space and takes tension off the inferior part of the flap.

Liposuction of the upper midline produces a xyphoumbilical groove. This simulates the groove seen between the bellies of the rectus muscles in athletic individuals.

The shape of the incision facilitates removal of skin and fat around the waist. This is frequently combined with circumferential liposuction to further define the waistline. Suction also helps eliminate "dog-ears" at the lateral ends of the incisions. The optimal location of the final suture line is medial and superior to the anterior superior iliac spine. Incisions that lie lower often produce a "tenting pole" effect on the flap so that it does not lie directly on the abdominal wall. This potential space can give rise to a seroma.

Although this incision creates a flap with a high length to width ratio and diminution of blood supply to the tip of the flap, we have had few cases of skin necrosis. We feel that this is because the maximum tension is at the lateral ends of the flap.

The myofascial release directs the pull of the external and internal oblique muscles towards the midline. The myofascial repair decreases the abdominal circumference, permitting the removal of more fat and skin.

Because the rectus muscles are relocated in the midline, they will flex the trunk more efficiently and act as an anterior pillar of support for the torso. All of our patients with preoperative symptoms of back pain noted an improvement after their abdominoplasty. Gracovetsky [10] postulated that the internal oblique and transversalis muscles pull the lumbodorsal fascia and decrease stress on the intervertebral joints.

10.8 Conclusions

The four components of the UM abdominoplasty provide a comprehensive treatment of the abdomen, even in the most severe cases. The patients get both functioning and cosmetic improvement (Figs. 10.1 – 10.3). The endoscopic abdominoplasty and the mini-abdominoplasty with a floating navel are used only for minor defects.

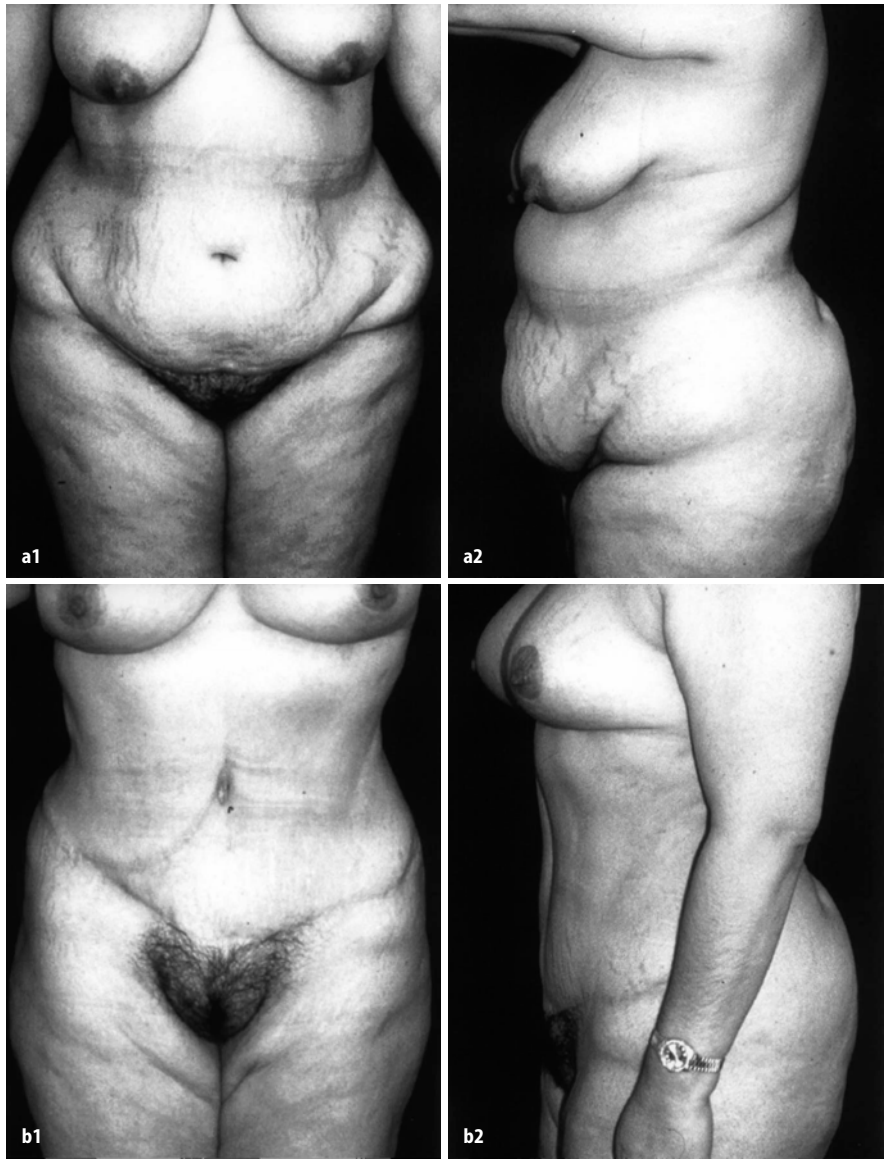


Fig. 10.2. a Preoperative showing poor abdominal tone, large amounts of iliac fat, and a ptotic pubis. Observe the position of the cholecystectomy scar. **b** Postoperatively showing a slimmer waistline, a raised pubis, and a more pleasing contour, especially around the iliac region. Observe the new location of the cholecystectomy scar. She also underwent a reduction mammoplasty

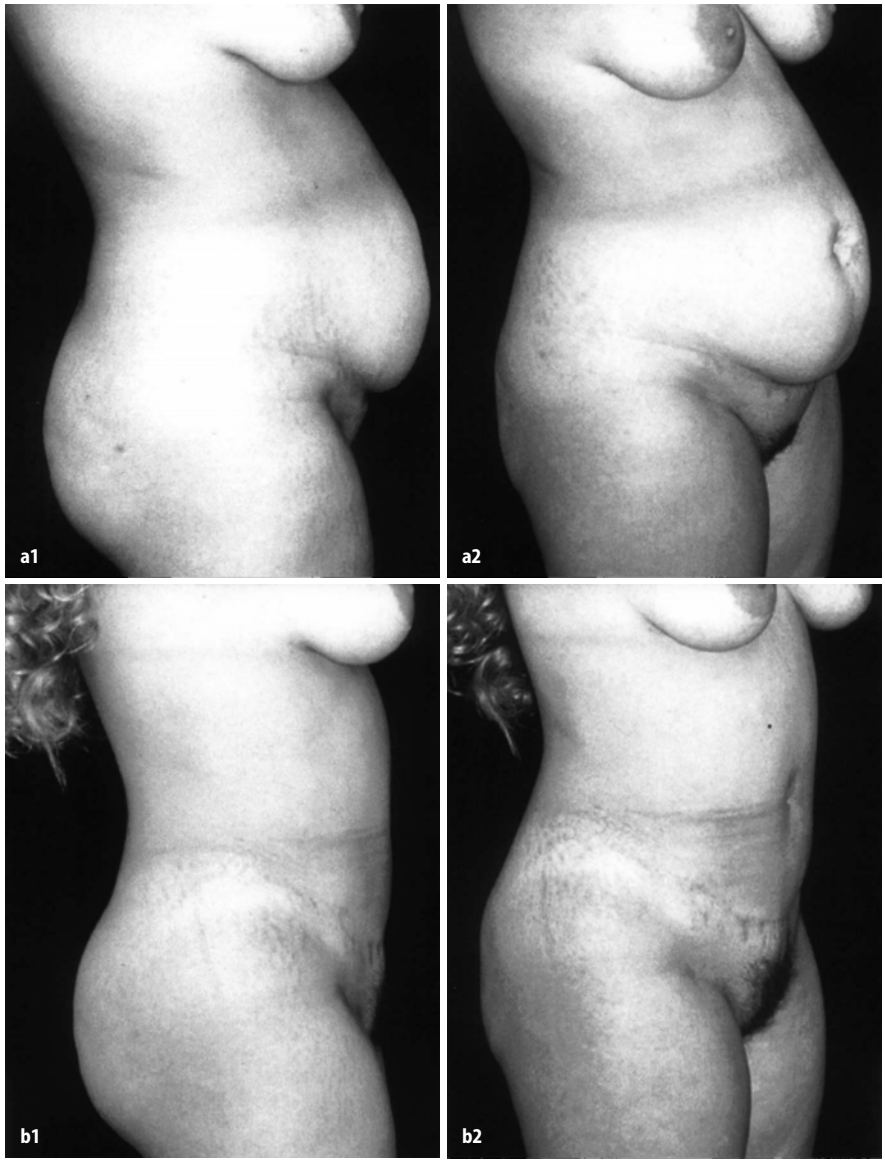


Fig. 10.3. a Preoperative patient with a protuberant abdomen after a twin pregnancy. She complained of disabling back pain. **b** Postoperatively showing the patient with improved posture and a flat abdomen

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Horseshoe Abdominoplasty

11

Richard Moufarrège

11.1 Introduction

Surgeons who perform abdominoplasties today typically use one of three general approaches: a horizontal incision through which it is possible to deal with the ptotic and excess skin in the vertical dimension, a vertical resection that allows access for treating the horizontal excess of skin at the level of the waist, or certain techniques that deal with both the vertical and horizontal excess. However, these techniques leave operative scars that prevent the patient from wearing a high-cut bathing suit or high-cut underwear. The horseshoe abdominoplasty combines the advantages of the horizontal and vertical techniques. Although a vertical component to the scar is unavoidable in certain cases, the procedure respects the need to limit incisions to sites where they will not be visible when the patient wears a high-cut bathing suit.

11.2 History

The first abdominoplasty was described by Demars in 1890 [1]. In 1899 Kelly [2] described a technique in which an ellipse of skin and subcutaneous tissue was excised through a transverse incision. However, the umbilicus was sacrificed (Fig. 11.1a). Gaudet and Morestin in 1905 [3] were the first to describe preservation of the umbilicus. Many authors have since described a variety of incisions and techniques to improve the contour of the abdomen, including Weinhold in 1905 [4] (cloverleaf incision) (Fig. 11.3c), Desjardins in 1911 [5], and Babcock in 1916 [6] (vertical elliptical resection) (Fig. 11.2a). In 1939 Thorek [7, 8] described a crescent horizontal resection without undermining (Fig. 11.1b). In 1955 Galtier [9] reported resection in four quadrants (Fig. 11.3b); this was followed by reports of circular abdominoplasty techniques by Gonzalez-Ulloa in 1960 [10] and Vilain and Dubousset in 1964 [11] (Fig. 11.1c). In 1965 Spadafora [12] described a curved transverse incision, and this was followed by reports of a low transverse incision technique by Pitanguy in 1967 [13, 14], 1971 [15] and 1974 [16] (Fig. 11.1e). This technique was modified by Grazer [17], who contoured the upper lateral incisions to hide them in the confines of bathing suits that were in vogue at that time (Fig. 11.1f). Régnault used a "W" incision (described in 1972 [18] and 1975 [19]) (Fig. 11.1g), and Baroudi's [20, 21] "bicycle handles" technique (Fig. 11.1d) was used in a further attempt to place the incisions so that they were less visible.

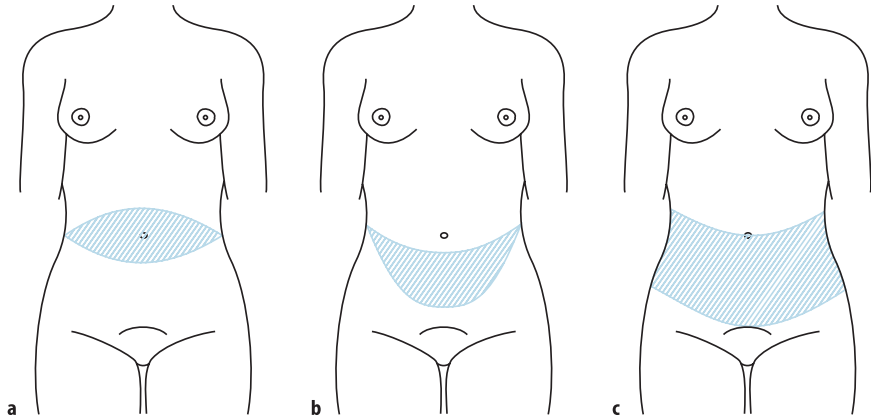


Fig. 11.1. a–g Horizontal techniques for the treatment of ptosis [1–7]. **a** Kelly, **b** Thorek, **c** Gonzalez-Ulloa

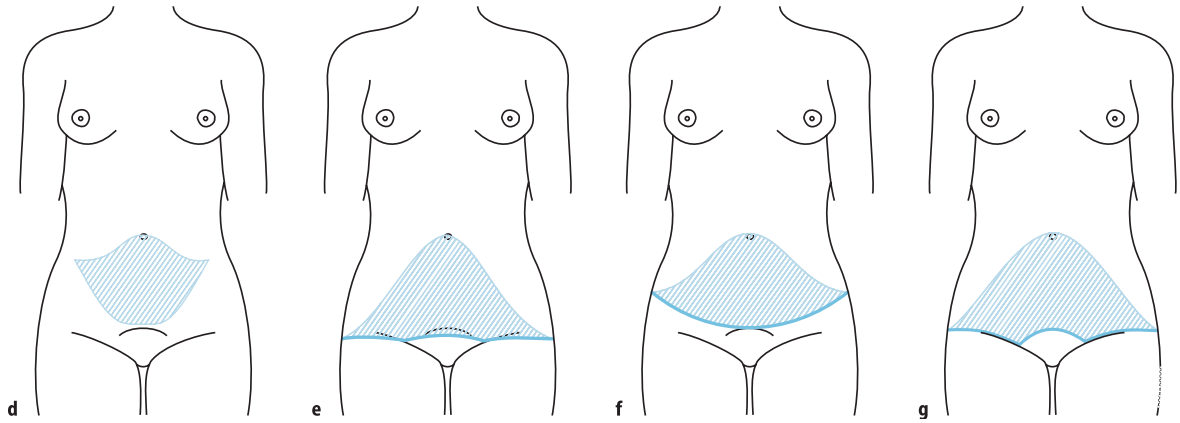


Fig. 11.1. d Baroudi, **e** Pitanguy, **f** Grazer, **g** Régnault

11.3 Classification

Abdominoplasties can be divided into the following three categories:

1. Horizontal resections that treat the skin excess and abdominal ptosis (Fig. 11.4) without treating the waist expansion (Kelly, Gonzalez-Ulloa, Thorek, Grazer, Pitanguy, Régnault, and Baroudi) (Fig. 11.1a–g)
2. Vertical resections (Babcock, Kuster, Schepelmann, and Desjardins) (Fig. 11.2a–c) to improve waist expansion (Fig. 11.5)
3. Combined abdominoplasties that deal with both the transverse and vertical components of the problem (Fig. 11.3a–e)

Unfortunately, the majority of the combined techniques result in a significant and frequently unacceptable scar. The "horseshoe abdominoplasty" that I have developed is a combined technique that permits resection of an amount of skin equivalent to that resected with other techniques currently in use. The horseshoe abdominoplasty treats both the transverse and horizontal components of the problem while the incision remains within the confines of high-cut bathing suits and underwear (Fig. 11.6).

11.4 The Horseshoe Abdominoplasty Technique

The short inferior incision used in the horseshoe abdominoplasty technique is similar in placement to that described by El Baz (Fig. 11.7) and Flageul. But El Baz recommended that method for a very small resection in the inferior area of the abdomen, without displacement of the umbilicus. Through this incision the Moufarrège technique will realize a complete radical abdominoplasty with a resection of enough skin to obtain a real abdominoplasty result and reconstitution of a new umbilicus in the right position. To obtain such a result, we have to undermine as far as the hips, correct the dia-

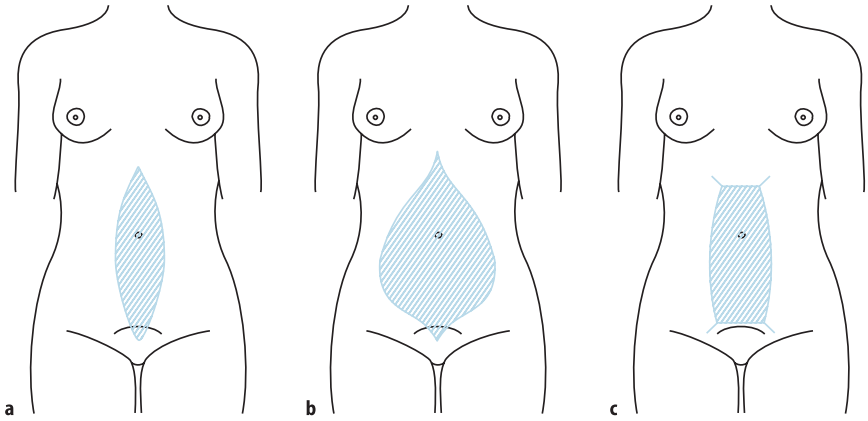
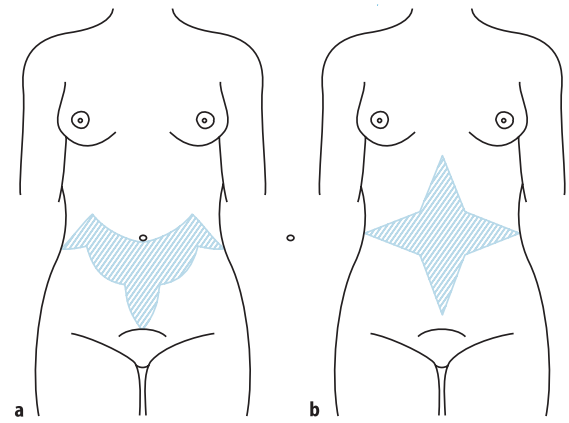


Fig. 11.2 a–c. Vertical techniques for treating the waist [24, 25]. **a** Babcock, **b** Schepelmann, **c** Kuster

stasis, and resect the excess of skin between the pubis and the umbilicus, subsequently reconstituting the umbilicus at its proper level.

We begin by drawing the horseshoe incision around the pubis with a downward notch centrally, which gives it a heart-shaped appearance. With this maneuver, vertical contracture of the central portion of the incision is avoided (Fig. 11.8a). A second similarly shaped incision that passes over the umbilicus is then drawn (Fig. 11.8b) and the skin between the two incisions is excised. We then undermine in the subcutaneous plane upward over the inferior two to three ribs, as well as laterally, undermining further than with other techniques



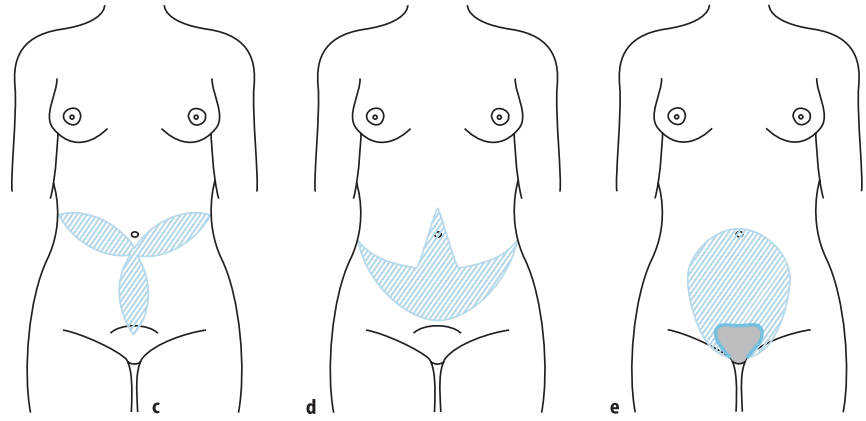


Fig. 11.3. a–e Mixed techniques for treating both waist and ptosis problems [22, 23]. **a** Pick, Barsky, **b** Galtier, **c** Weinhold, **d** Flesh-Thebesius, Weisheimer, **e** Moufarrège

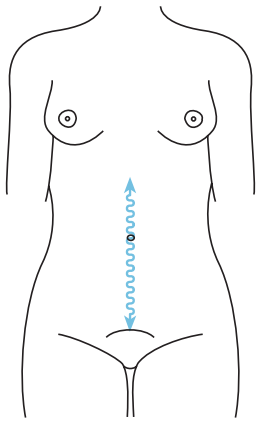


Fig. 11.4. Vertical stretching causes skin ptosis

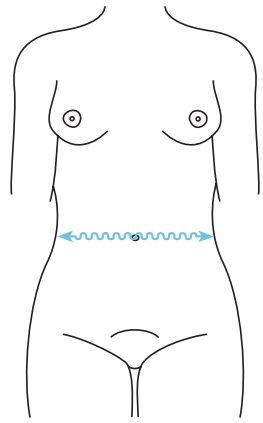


Fig. 11.5. Horizontal stretching causes waist enlargement

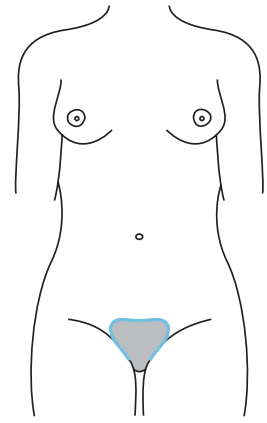


Fig. 11.6. The horseshoe abdominoplasty treats the transverse and horizontal components while the incision remains within the confines of high-cut bathing suits and underwear (Moufarrège)

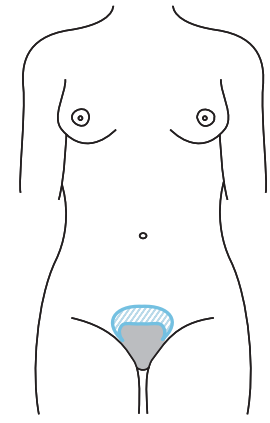


Fig. 11.7. Short inferior incision of El Baz [26, 27]

(as far as 10 cm) on the sides of the abdomen. The diastasis is then corrected (Fig. 11.8b). With subsequent closure, force is exerted in a direction that helps to address the waistline and vertical excesses (Fig. 11.9). Closure is accomplished with considerable shirring of the upper incision to the lower incision (Fig. 11.10). Puckering improves over 3 – 6 months.

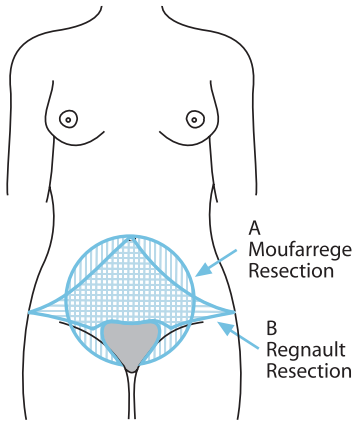


Fig. 11.8. A Begin by drawing the horseshoe incision around the pubis with a central downward notch to avoid vertical contracture of the central portion of the incision. **B** A second similar-shaped incision that passes over the umbilicus is then drawn, the skin is removed between the lines, and the diastasis repaired after dissection

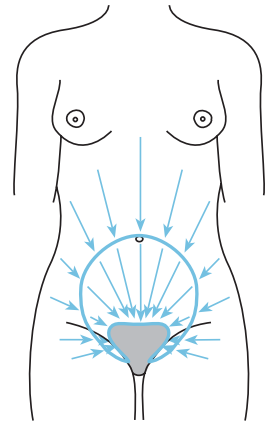


Fig. 11.9. Orientation of traction for closure

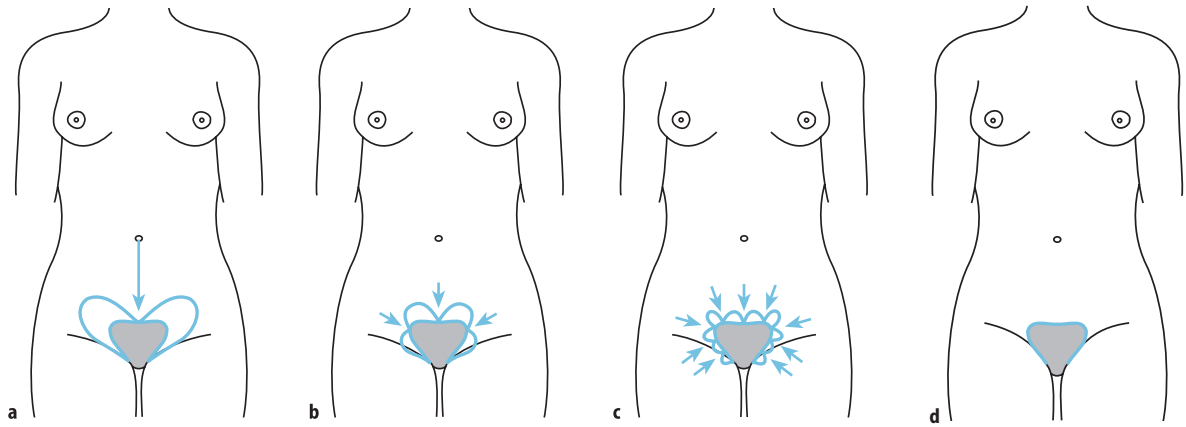


Fig. 11.10. a–c Progressive closure; **d** final result

11.5 Discussion

The Moufarrège horseshoe abdominoplasty is not the panacea for all abdomens. Its utilization should be limited to a very strict category of patients. Abdominoplasty patients are divided into four main categories.

Category I: The slim patient who has a very small pad of under cutaneous fat

Category II: The patient is relatively slim but has a certain amount of fat in the subcutaneous layer (until 2 cm). But skin does not hang in front of the pubic area in an overlap fashion (no apron).

Category III: The patient, without being obese, has a big amount of excess of skin, which drops in front of the pubic area (the apron).

Category IV: The obese patient.

11.5.1 Patient Selection

The selection of candidates for the horseshoe is very important and must obey very strict rules. When the patient is not the ideal candidate for the technique, one will realize that the corrective procedure has to be performed more often than with average techniques.

From 1991 to 1993, our incidence of revision was about 40 % of cases. Since we tightened the criteria in the choice of candidates, our revision ratio has dropped to less than 10 %. In any circumstances, correction procedures should not take place before 1 year after the first surgery.

I limit the horseshoe abdominoplasty procedure to Category I patients. Even in these, we have to avoid performing the procedure in patients presenting stretch marks in the upper incision line. These stretch marks will prevent the upper flap from adapting to the lower edge of the wound, which is by far shorter. All in all, we consider that only 10 % of our abdominoplasty patients can undergo the horseshoe abdominoplasty.

In Category I patients with stretch marks at the sec-

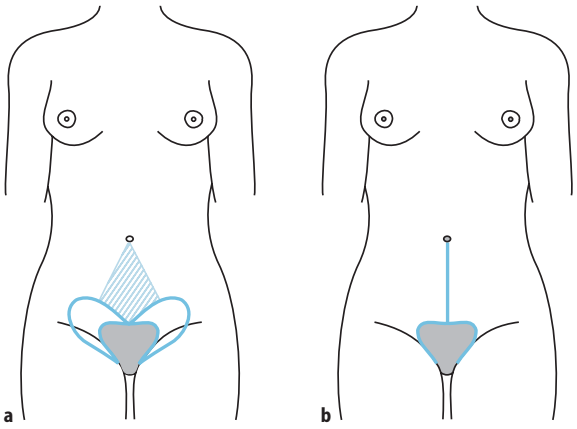


Fig. 11.11. a Supplemental wedge resection in Category II patients and Category I patients with stretch marks; **b** final result with supplemental wedge resection

tion line of the upper flap and in Category II patients, the horseshoe could be used with a triangular supplementary resection in the upper flap. This consists of a wedge resection having its summit at the umbilicus and its base on the free edge of the upper flap (Fig. 11.11a). The final result will consist in a horseshoe surrounding the pubic area with a medial vertical incision, which will go from the umbilicus down to the horseshoe (Fig. 11.11b).

In Category III patients one should use one of the classical low horizontal incisions, e.g., Baroudi's. One should avoid operating on Category IV patients (obese) until they lose their excess fat and become Category III patients.

11.6 Conclusions

The horseshoe abdominoplasty is an interesting and advantageous alternative to other types of abdominoplasty. Its short and well-placed incision makes it easily hidden in a high-cut bathing suit and underwear. The horseshoe is a mixed technique, improving the ptosis of the skin as much as the waist enlargement. But one should be very conservative and not permissive in the selection of patients. The surgeon must also always present to the patient the possibility of a scar revision a year after the procedure, even for those who constitute an ideal candidate.

11.7 Illustrations of Different Patient Categories

The following photographs provide illustrative pre- and postoperative images of different categories of patients with occasional comments with regard to technique (Figs. 11.12 – 11.27).

Fig. 11.12a,b. Horseshoe abdominoplasty, Patient no. 1, Category 1. **a** Front view, preoperative. **b** Front view, postoperative

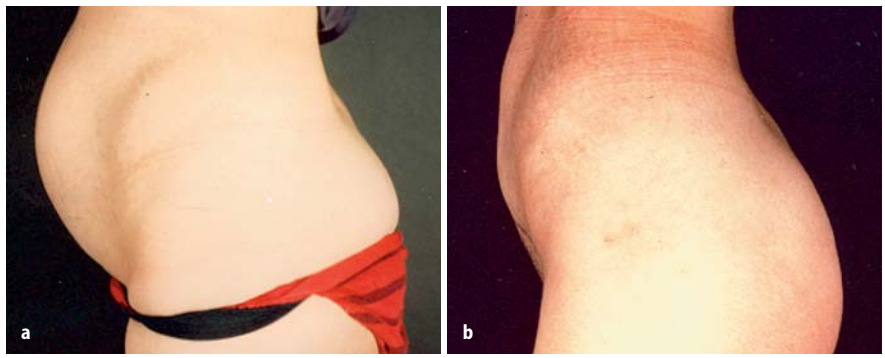


Fig. 11.13a,b. Horseshoe abdominoplasty, Patient no. 1, Category 1. **a** Lateral view, preoperative. **b** Lateral view, postoperative

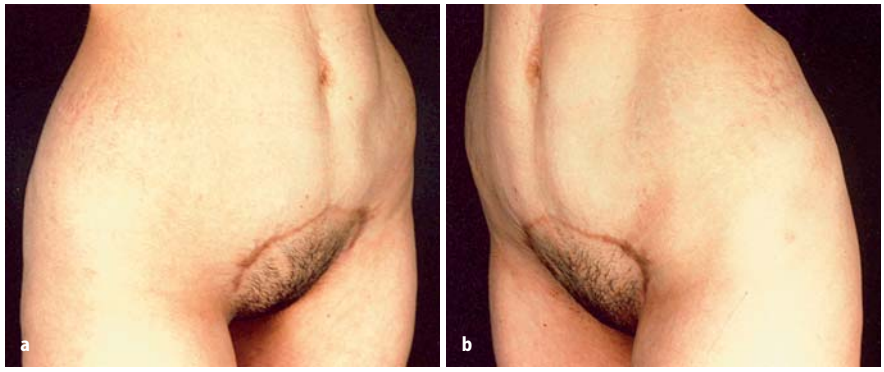


Fig. 11.14a,b. Horseshoe abdominoplasty, Patient no. 1, Category 1. **a** Right oblique view, postoperative. **b** Left oblique view, postoperative. Please note the definition of the rectus abdominis muscle

Fig. 11.15a,b. Horseshoe abdominoplasty, Patient no. 2, Category 1. **a** Front view, preoperative. **b** Front view, postoperative

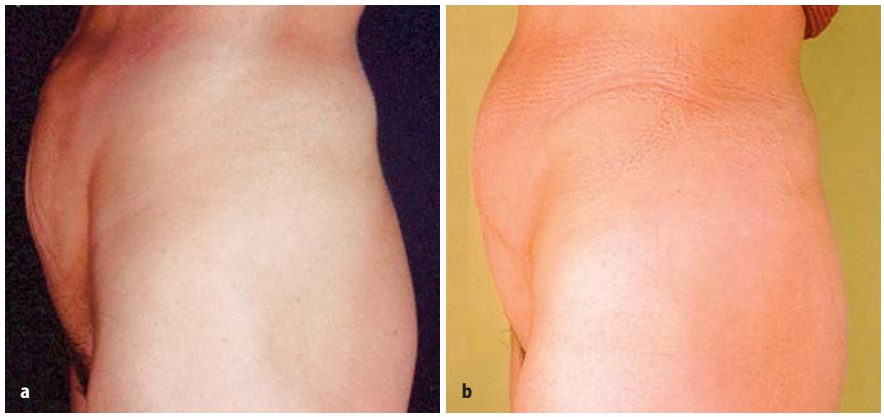


Fig. 11.16a,b. Horseshoe abdominoplasty, Patient no. 2, Category 1. **a** Lateral view, preoperative. **b** Lateral view, postoperative

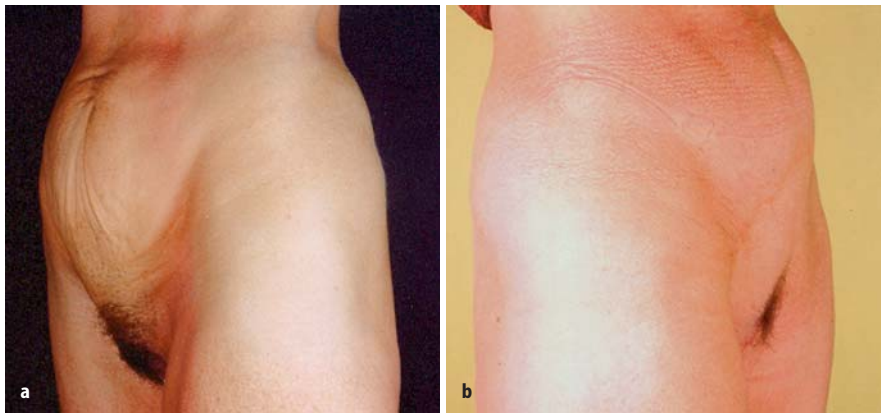


Fig. 11.17a,b. Horseshoe abdominoplasty, Patient no. 2, Category 1. **a** Oblique view, preoperative. **b** Oblique view, postoperative

Fig. 11.18a,b. Horseshoe abdominoplasty, Patient no. 3, Category 2. **a** Front view, preoperative. **b** Front view, postoperative

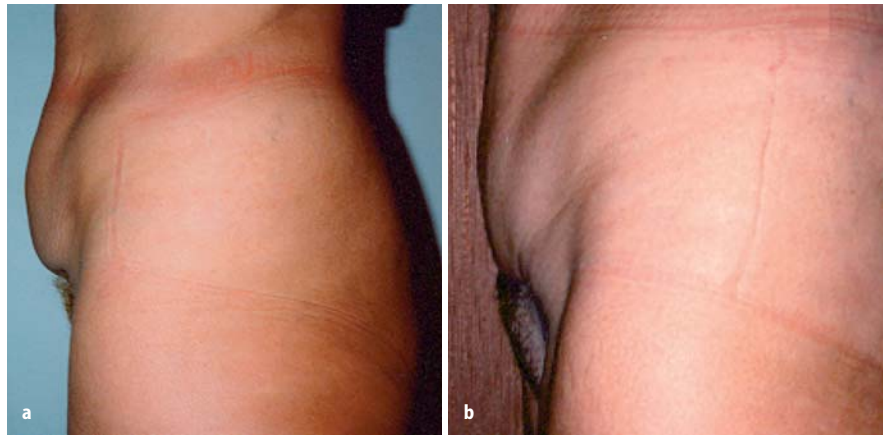


Fig. 11.19a,b. Horseshoe abdominoplasty, Patient no. 3, Category 2. **a** Lateral view, preoperative. **b** Lateral view, postoperative

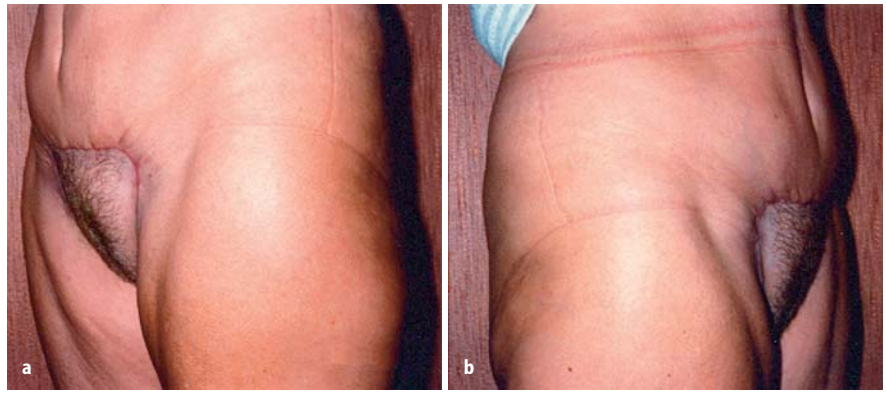


Fig. 11.20a,b. Horseshoe abdominoplasty, Patient no. 3, Category 2. **a** Oblique view, preoperative. **b** Oblique view, postoperative. This Category 2 patient was operated on in the mid-1990s using a horseshoe technique. If I had to operate on her now, I would choose either the horseshoe with a medial vertical wedge resection or the bicycle handle incision

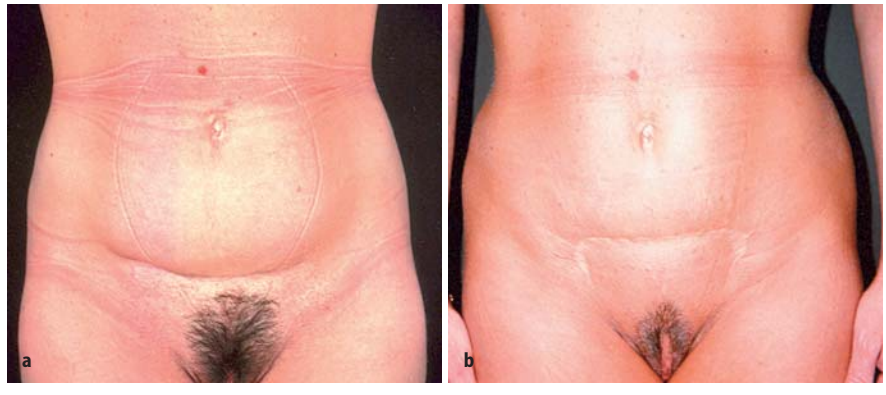


Fig. 11.21a,b. Horseshoe abdominoplasty, Patient no. 4, Category 2. **a** Front view, preoperative. **b** Front view, postoperative

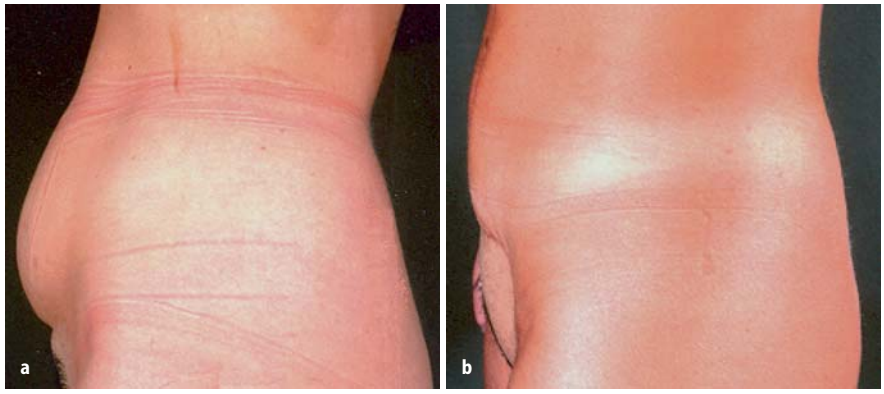


Fig. 11.22a,b. Horseshoe abdominoplasty, Patient no. 4, Category 2. **a** Lateral view, preoperative. **b** Lateral view, postoperative

Fig. 11.23a,b. Horseshoe abdominoplasty, Patient no. 4, Category 2. **a** Right oblique view, postoperative. **b** Left oblique view, postoperative. Once again, this Category 2 patient was operated on in the mid-1990s using a horseshoe technique. If I had to operate on her now, I would choose either the horseshoe with a medial vertical wedge resection or the bicycle handle incision

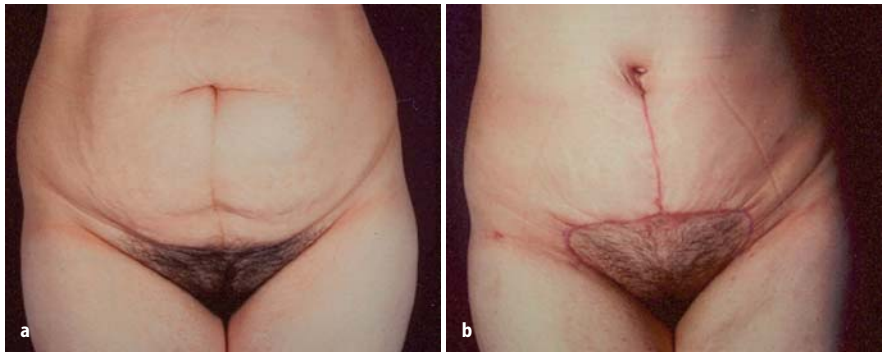


Fig. 11.24a,b. Horseshoe abdominoplasty, Patient no. 5, Category 2. **a** Front view, preoperative. **b** Front view, postoperative

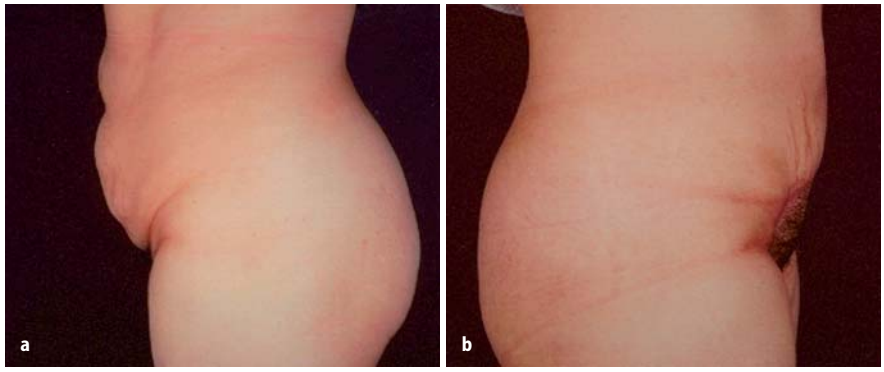


Fig. 11.25a,b. Horseshoe abdominoplasty, Patient no. 5, Category 2. **a** Lateral view, preoperative. **b** Lateral view, postoperative

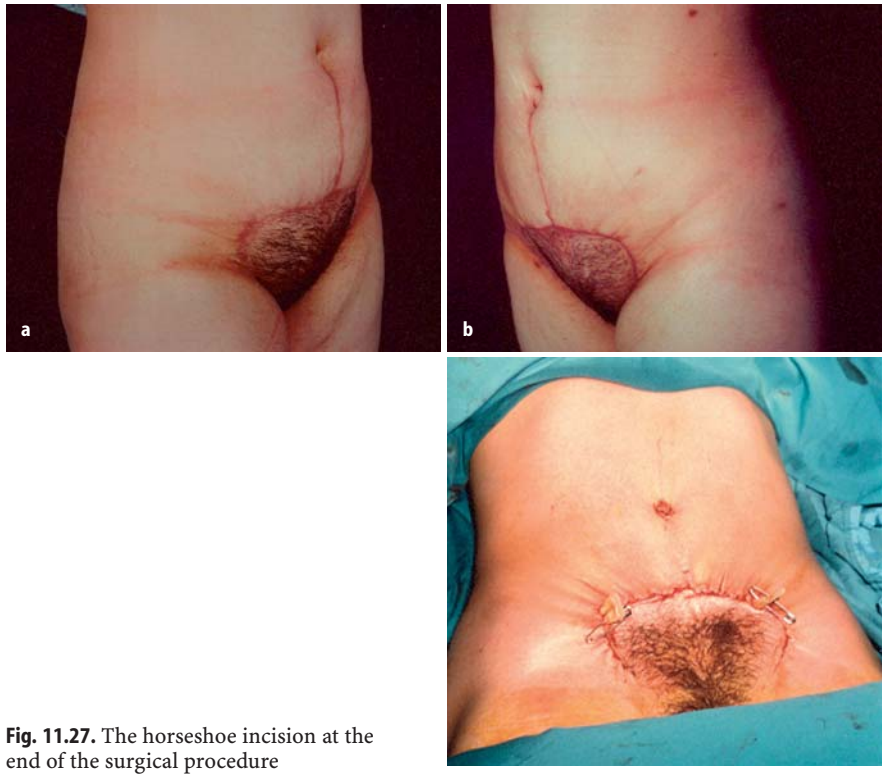


Fig. 11.26a,b. Horseshoe abdominoplasty, Patient no. 5, Category 2. **a** Right oblique view, postoperative. **b** Left oblique view, postoperative. This Category 2 patient has been treated using the modified horseshoe abdominoplasty with a the medial vertical wedge resection ending with a medial vetical incision over the horseshoe incision

Fig. 11.27. The horseshoe incision at the end of the surgical procedure

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12 Umbilical Approach in Aesthetic Abdominal Surgery

Jacques Faivre, Jean-Marie Faivre, Chiraz Moheli

12.1 Introduction

The umbilicus in abdominal aesthetics is an important site from both an aesthetic and a symbolic standpoint. Most often it is the site of unsightly lesions such as stretch marks, folding, and distension, for which treatment is difficult.

12.2 Anatomy

The umbilicus is embryonic in origin and is prone to give rise to poor quality scars. This midline depression is 10 – 12 cm superior to the pubic hairline. Its shape is quite variable, either round or oval, depending on the postnatal scarring of the umbilical cord.

12.3 Abnormalities of the Umbilicus

Aesthetic alterations to the umbilicus can be:

1. Isolated
2. Associated with more or less significant fatty excess
3. Associated with musculoaponeurotic diastasis that is centered over the umbilicus and may be associated with an umbilical hernia
4. Associated with a combination of cutaneous fatty ptosis leading to a “folded hat” shaped deformity of the umbilicus.

The incidence of these umbilical variations and their aesthetic importance explains the significance of the umbilical incision in aesthetic abdominal surgery.

12.4 Correction of Isolated and Unsightly Umbilical Lesions (Figs. 12.1 – 12.8)

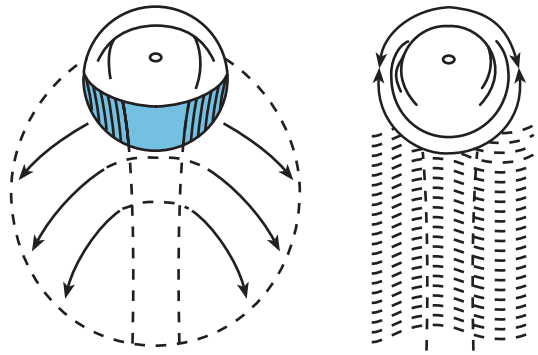

Fig. 12.1. Periumbilical incision for suturing musculoaponeurotic diastasis

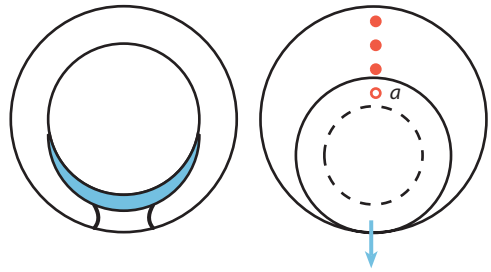

Fig. 12.2. The musculoaponeurotic suture pulls the umbilical stump inferiorly in order to tighten the supraumbilical skin. The final suture (point *a*) in the musculoaponeurotic fascia is placed in contact with the base of the umbilical stump

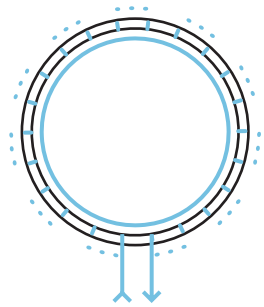

Fig. 12.3. Absorbable sutures (overcast stitch) are used to close the subdermal tissues through the complete circumference

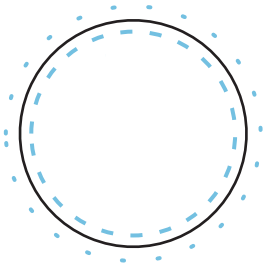

Fig. 12.4. Absorbable overcast suture is used to close dermal to dermal

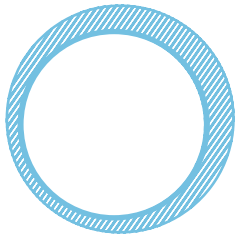

Fig. 12.5. Irregularities of the umbilical skin edges are trimmed

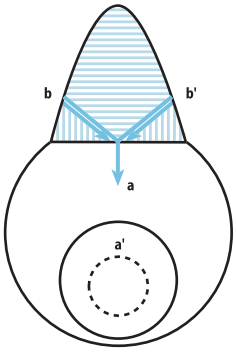

Fig. 12.6. Supraumbilical folds and stretch marks require removal of the epidermis but should not exceed 2 – 3 cm. The dermal fragment thus created should be sectioned, *b* to *b'*, to lower it in the direction of the base of the umbilical stump. The peak *a* of this fragment should be sutured in contact with the base of the umbilical stump at point *a'*

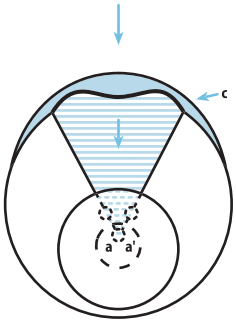

Fig. 12.7. Traction of the epidermal fragment inferiorly leads to irregularity of the upper pole and further removal of the epidermis will correct this

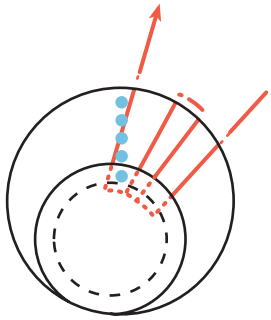

Fig. 12.8. The deep plane suture anchors the abdominal subdermal region to the mid part of the umbilical stump. A superficial dermodermal suture brings the two epidermal edges together

The anatomical cosmetically unsightly abnormalities can be:

1. Supra- and infraumbilical folds either isolated or combined
2. Stretch marks
3. Enlarged or distended umbilicus usually due to an umbilical hernia

These lesions can only be corrected transumbilically if they are located within 2 cm above or below the upper or lower poles of the umbilicus. These can be corrected by the combination of a cutaneous incision, detachment of the umbilical stump, liposuction, and proper suturing.

This incision must be circular, not V-shaped, outside the embryonic skin of the umbilical cord. The incision should be in the sloping portion of the abdominal wall skin around the umbilicus.

The umbilical stump should be detached subcutaneously down to the musculoaponeurotic plane. If diastasis is present, this should be completely exposed with the dissection.

Liposuction of localized umbilical fatty excess is essential in order to mobilize the soft tissues and resolve the fatty protrusion.

Closure should be in layers with absorbable sutures in the subdermal plane without tension. The epidermis is trimmed to make the umbilicus uniformly round and then closed with intradermal absorbable sutures. Scarring is usually minimal.

12.5 Umbilical Approach to Treat Unsightly Lesions of the Abdomen

Traditionally, in order to repair the musculoaponeurotic diastasis, a sufficiently long suprapubic incision with detachment of the umbilicus is necessary. The diastasis is widest at the umbilical area and an umbilical hernia can be present. By utilizing the umbilical approach, there is less tissue flap and, therefore, hematoma and lymphorrhea can be avoided.

The periumbilical incision is in the sloping area of the abdominal wall. Liposuction is performed allowing slight detachment over the median line. Umbilical stump dissection is done under direct visualization and the median line is dissected superiorly and inferiorly extending laterally to the medial edge of the rectus abdominus muscles.

The musculoaponeurotic defect is sutured along its entire length. A lighted instrument is helpful to carry out this maneuver. The base of the umbilical stump should be lowered with a couple of musculoaponeurotic sutures by 1 – 2 cm in order to regain tautness in the

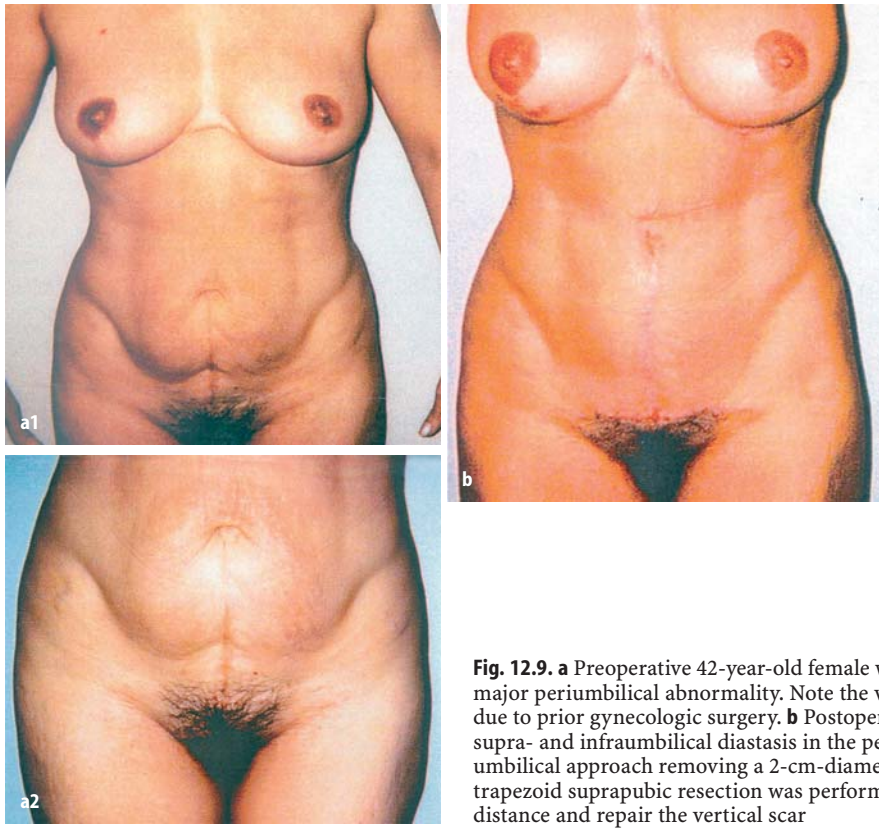

Fig. 12.9. a Preoperative 42-year-old female with distended abdomen and major periumbilical abnormality. Note the vertical lower abdominal scar due to prior gynecologic surgery. **b** Postoperative following treatment of the supra- and infraumbilical diastasis in the periumbilical region through an umbilical approach removing a 2-cm-diameter area of periumbilical skin. A trapezoid suprapubic resection was performed to reduce the umbilicopubic distance and repair the vertical scar

supraumbilical skin. At the same time the umbilical scar will tend to become invaginated and less visible.

The periumbilical skin is cut to a round or oval shape and the umbilical stump sutured to the abdominal skin in two layers, dermodermal and intradermal. Drains are placed in the area through pubic incisions.

12.6 Conclusions

The umbilical approach enables the repair of localized umbilical and periumbilical abnormalities with minimal scarring (Figs. 12.9, 12.10). The musculoaponeurotic defect from the xyphoid to pubis can be repaired without a long suprapubic scar and without wide subcutaneous detachments that might lead to hematoma and lymphorrhea.

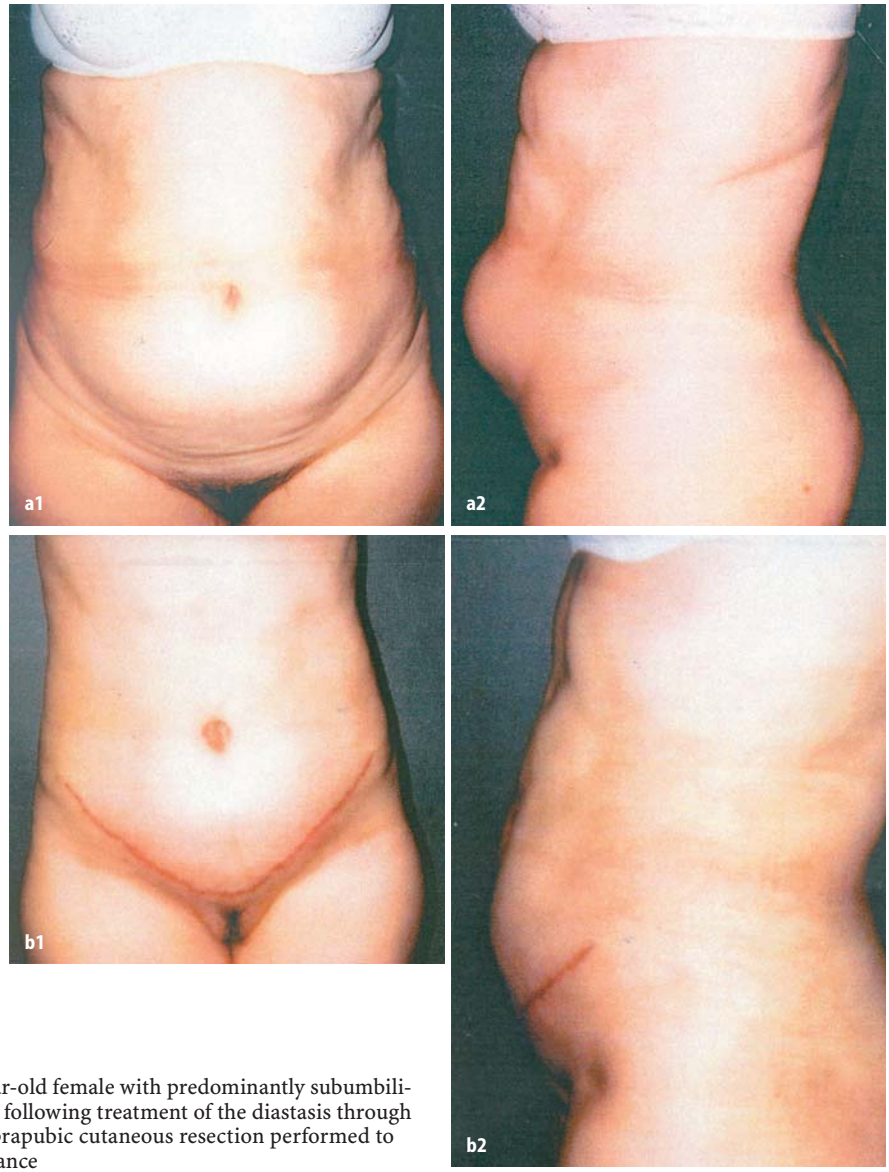

Fig. 12.10. a Preoperative 45-year-old female with predominantly subumbilical fatty excess. **b** Postoperative following treatment of the diastasis through the umbilical approach and suprapubic cutaneous resection performed to reduce the umbilical pubic distance

13 Abdominoplasty With Only Cutaneous Resection and Without Deep Detachment

Jacques Faivre, Jean-Marie Faivre, Chiraz Moheli

13.1 Introduction

With the introduction of liposuction, the surgeon now has the capability of performing abdominoplasty without extensive detachment, cutaneous necrosis, lymphorrhagia, and unsightly scarring. The principles of this method require:

1. Extensive liposuction of the supra- and infraumbilical regions and the hips (in order to mobilize all of the soft tissue)
2. Tissue resection restricted to the skin that preserves the vascular supply to prevent cutaneous damage or necrosis
3. Low skin incision at the level of the pubic hairline in the bathing suit line
4. Corrections of abdominal wall lesions such as diastasis and hernia through an umbilical approach with limited subcutaneous detachment
5. Tightening of the soft tissues by suturing in three planes

13.2 Abdominoplasty Without Periumbilical Incision

The periumbilical incision (see Chapter 12) is not necessary if there is no musculoaponeurotic lesion such as diastasis or hernia and no cutaneous periumbilical lesions such as stretch marks, folds, or deformation of the umbilicus.

Excessive fat can occur either generalized, supra- and infraumbilical, or periumbilical alone. This can cause distention of the skin, stretch marks, and/or thin skin folds. Liposuction alone does not usually give a good result. Liposuction with skin tightening is necessary and is achieved through skin resection and suture closure at three levels. The epidermal surfaces must be brought together without tension in order to achieve good quality scar formation.

13.2.1 Preoperative Markings

The inferior incision line is located 2 – 3 cm from the upper edge of the pubic hairline through the hair with an upper concavity. The incision extends laterally beyond the pubic hair but within the line of the undergarments.

The superior incision line depends upon the topography of the fat excess but must conserve the 10 – 12 cm distance from the lower pole of the umbilicus to the lower incision.

13.2.2 If the Excess Fat Is in the Median Line and Predominantly Infraumbilical

The upper incision can be either arch shaped with a superior concavity similar to the lower incision (Fig. 13.1) or trapezoid (Fig. 13.2) if there is lateral cutaneous distention. Dermis only is resected protecting the underlying fat and superficial fascia. The defect is closed by anchoring sutures in the fascia, suturing the dermodermal plane, and an intradermal running absorbable suture. Fat excess may then be observed in the pubic area that should be treated with liposuction.

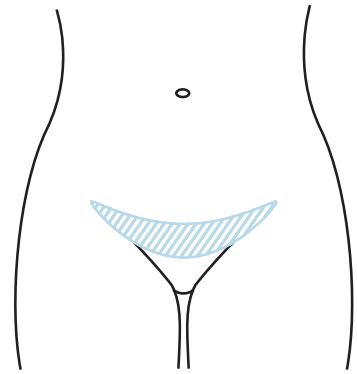

Fig. 13.1. Arch shaped approach

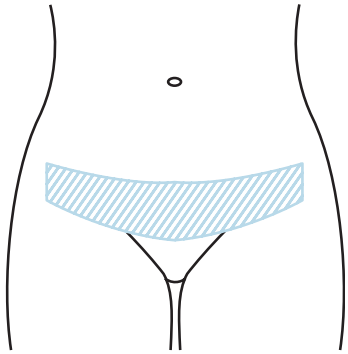

Fig. 13.2.
Trapezoid approach

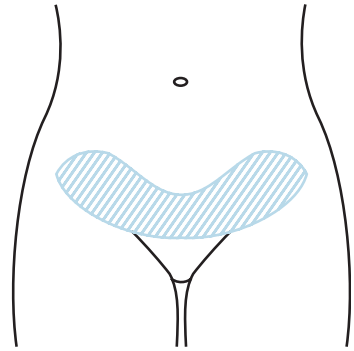

Fig. 13.3.
Butterfly wing approach

13.2.3
If the Fatty Excess Is Mainly Lateral

Fat excess and lateral skin distention requires that there be at least 10 cm between the lower pole of the umbilicus and the pubic incision. Since lateral cutaneous excision must be greater, the markings should be butterfly wing shaped (Fig. 13.3) with more lateral extension in the line of the undergarments (Fig. 13.4). If the umbilicopubis distance is short, the excision should be in the shape of butterfly wings. If the umbilicopubis distance is long, the trapezoid shape of excision should be used.

13.3
Abdominoplasty with Obligatory Umbilical Incision (Figs. 13.5 – 13.7)

There are two situations where an umbilical incision is necessary: (1) in the presence of periumbilical folds, stretch marks, or umbilical distortion; and (2) where there are musculoaponeurotic disorders that need to be corrected. Liposuction remains the first and most important stage for the reduction of fat.

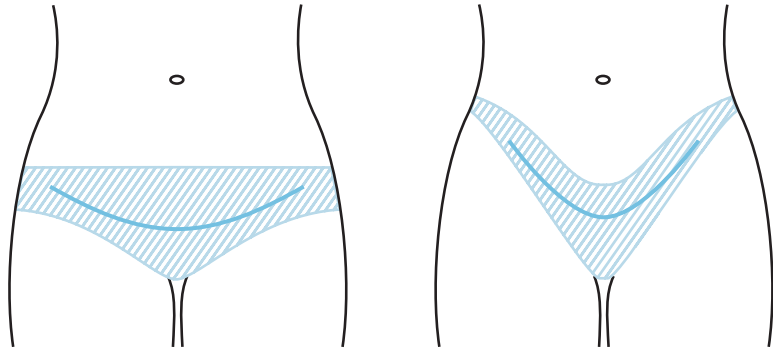

Fig. 13.4. The scar should be within the line of the undergarments

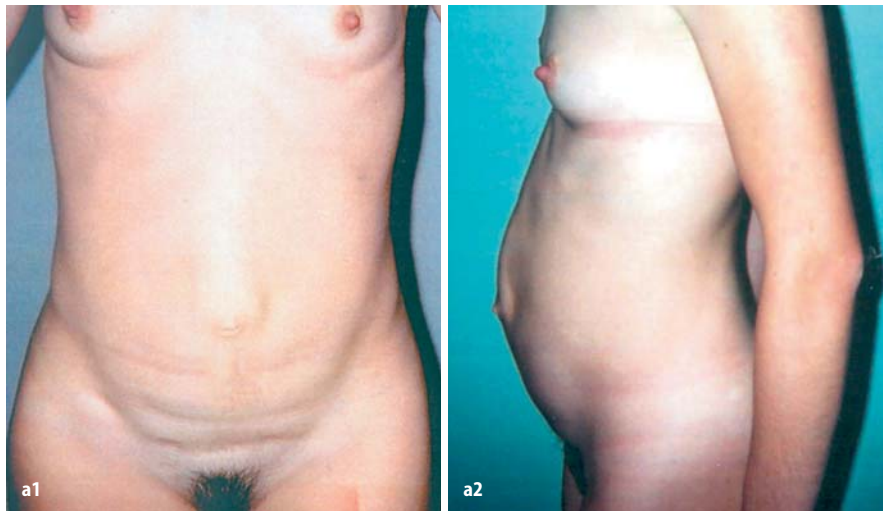

Fig. 13.5. a Thirty-five-year-old female with large diastasis recti

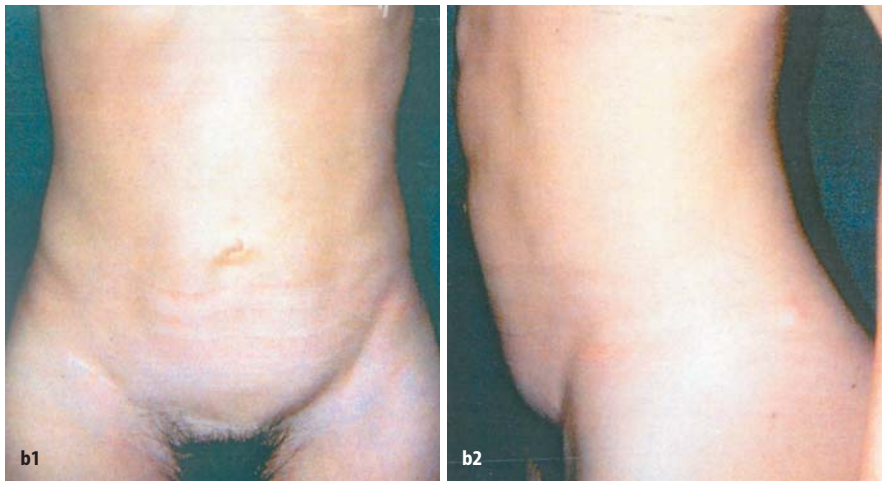

Fig. 13.5. b Postoperatively following correction by crescent-shaped cutaneous resection, liposuction, and umbilical approach to repair of the diastasis

Fig. 13.6. a Thirty-eight-year-old female with abdominal lipodystrophy and diastasis recti. **b** Postoperative following suprapubic trapezoid resection and correction of diastasis through the umbilical approach

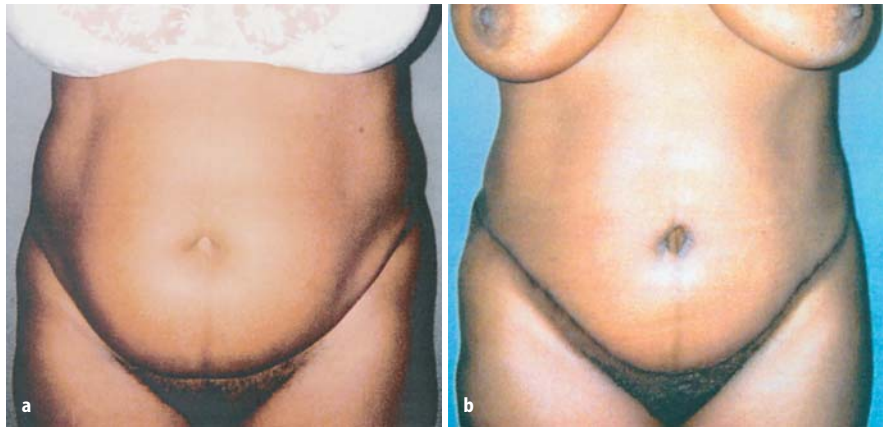

Fig. 13.7. a Forty-two-year-old female with pouch-like abdomen and diastasis. **b** Postoperative following suprapubic butterfly wing cutaneous resection and repair of the diastasis through the umbilical approach

13.4 Conclusions

The limited approach for abdominoplasty with liposuction as the main component avoids many of the complications of the traditional abdominoplasty. Skin resection alone is performed with an umbilical approach to diastasis and periumbilical folds or striae.

14 Endoscopic Intracorporeal Abdominoplasty

Mark L. Zukowski

14.1 Introduction

The specialty of plastic surgery has witnessed an explosion of novel procedures with the advent of endoscopy. Surgeons are making more aggressive attempts to reduce the length of scars and subsequent morbidity associated with traditional "open" procedures. This presents a new technique of endoscopic abdominoplasty as an alternative to the traditional "full open" technique. This technique of endoscopic intracorporeal abdominoplasty combines traditional and ultrasonic abdominal wall liposuction with endoscopic intracorporeal plication of the rectus fascia by using a series of horizontal mattress sutures. Eighty-five patients undergoing intracorporeal abdominoplasty were compared with 25 patients who underwent traditional open abdominoplasty with anterior plication of the rectus fascia. Our conclusion is that the endoscopic intracorporeal abdominoplasty reduces operative scars and effectively plicates the rectus fascia, thereby reducing abdominal wall laxity. It has a rate of morbidity in a skilled laparoscopist's hands no greater than with traditional open abdominoplasty.

Surgical correction of abdominal wall laxity, tissue redundancy, and increased lipodystrophy through an open abdominoplasty procedure has been an accepted practice since the mid-twentieth century [1]. The procedure has been revised and updated countless times, whereas the principal tenets of reduction of the redundant panniculus and correction of rectus fascia diastasis have remained. With the advent of suction lipectomy in the early 1980s, a series of classifications of patients seeking abdominal contouring were devised [2, 3]. These classifications attempted to do away with the concept of one operation for all types of skin laxity and diastasis [4–7]. This led to the development of a number of procedures designed to achieve more natural aesthetic results and simultaneously minimize resultant surgical scars. As early as 1985, the "limited" abdominoplasty was described for individuals who did not require the extended incisions of a standard abdominoplasty [8–13]. Modifications of the technique of "limited" or "mini-abdominoplasty" concentrated on limiting the incision and degree of undermining while continuing to plicate the rectus fascia. Others have modified the standard abdominoplasty to incorporate treatment for morbidly obese patients and for those who need minimal lipectomy [14, 15]. Variations in the placement of the rectus plication stitches, such as transverse plication in the epigastrium, have been attempted with some success to achieve a more aesthetic body contour [16]. The advent of minimally invasive surgery has led surgeons to seek a method that would provide cosmetic improvement of the abdominal wall laxity and rectus diastasis and would minimize the resultant scar. Endoscopically assisted techniques of abdominoplasty such as plication of the rectus fascia through an umbilical incision by using an endoscopic retractor were described. These approaches have been labeled "prefascial endoscopic abdominoplasties" [17, 18]. Liposuction combined with either "open" mini-abdominoplasty or endoscopically assisted abdominoplasty has produced excellent results because of a combination of skin contraction and removal of excess skin [19–22]. New techniques of body contouring and abdominoplasty have been combined with brachioplasty, belt lipectomy, breast reduction, and other aesthetic procedures producing safe and effective results. This reduces the need for multiple surgical procedures [23–28].

In 1993, a description of a laparoscopic approach to posterior rectus diastasis repair was reported in cadavers [29]. Similar studies have been performed in dogs by Vasconez [30]. In these cases, intracorporeal suture placement was used to plicate only the posterior rectus fascia and failed to produce adequate postoperative plication. The sutures that were placed resulted in a tight posterior fascia but increasing diastasis of the rectus muscle and anterior fascia. Scheflan [31] reported his experience with laparoscopic plication of the rectus performed on a single patient in combination with ultrasonic liposuction and provided the inspiration to develop and explore this technique.

14.2 Endoscopic Abdominoplasty

Between January 1995 and March 1997, a surgical team at the Naval Medical Center, Portsmouth, Virginia, performed 85 endoscopic intracorporeal abdominoplasties. All patients were women, ranging in age from 21 to 50 years (average 33 years). Fifty-four percent of the patients (46 of 85) had undergone one previous abdominal operation, and 35 % of these patients (16 of 46) had undergone multiple abdominal operations. These previous surgeries included 44 cesarean sections, 8 open appendectomies, 7 endoscopic tubal ligations, 6 diagnostic laparoscopies, 3 open total abdominal hysterectomies with bilateral salpingo-oophorectomies, 2 open total abdominal hysterectomies, 2 open cholecystectomies, 2 laparoscopic cholecystectomies, 2 ectopic pregnancy removals, 1 exploratory laparotomy, and 1 open umbilical hernia repair. Informed consent was obtained, and all patients were given the option of any abdominoplasty procedure currently available. Board-certified general and/or plastic surgeons were present during all of the intracorporeal procedures; however, the procedure could be performed effectively with a single surgeon and a surgical technician used as an assistant [32].

The patients selected for this type of surgery were those who had significant diastasis with anterior abdominal wall lipodystrophy. Patients with a large amount of abdominal wall striae and loss of elasticity and tone were avoided because it was believed that these patients would not experience as much skin shrinkage after aggressive suction lipectomy. Patients who had undergone previous intra-abdominal procedures were also avoided, but as our experience with the procedure grew, a history of previous intra-abdominal surgery no longer became a contraindication.

All procedures were performed under general anesthesia. An epidural anesthetic was recommended to all patients beginning in October 1995 to relieve both muscle spasm and pain postoperatively. It consisted of a combination of Duramorph for pain and bupivacaine for spasm, used independently or in combination at the anesthesiologists' discretion. A typical dosage of Duramorph was a 50-µg/kg loading dose, followed by a continuous infusion of 8 – 10 ml/h or a 50-µg/ml solution either alone or in combination with bupivacaine in a 0.75-mg/ml dose. This anesthetic is considered completely cleared 6 h after cessation of continuous infusion. This is important because the epidural anesthetic was discontinued the morning of the patient discharge from the hospital. Before induction of general anesthesia, thigh-high hose and pneumatic compression devices were placed bilaterally on the lower extremities. In addition, a Foley catheter and an oral gastric tube were placed for maximal decompression of abdominal contents. Before incision, all patients were given 1 g of cephazolin intravenously. Some patients received 10 mg of Decadron intravenously before the start of the case. The patient was positioned with the primary surgeon and the surgical scrub positioned on the patient's right and the assistant positioned on the patient's left (Fig. 14.1). Two monitors were positioned such that the primary surgeon and the assistant could visualize the screens easily. The procedure can be performed easily with one monitor. The technique involves an initial conventional tumescent liposuction of the anterior abdominal wall and flanks. Approximately 2 – 3 l of a tumescent solution containing 1,000 cc of Ringer's lactate, 50 cc or 7.5 % sodium bicarbonate, 20 cc of 1 % plain lidocaine, and 1 cc of 1 : 1,000 epinephrine was infiltrated into the pannus using the Hunstad needle system. The liposuction was performed through three 1-cm incisions located at the umbilicus, in the left lower quadrant of the abdomen 2 cm above the anterior superior iliac spine, and in the right upper quadrant 2 cm below the right costal margin (Fig. 14.2). After completion of liposuction, the peritoneal cavity was entered with a Verres needle or the Hassan open technique at the umbilical incision. Verres needle position was checked by free flow of saline into the peritoneal cavity. The abdomen was then insufflated to 15 lbs. of pressure with CO_2. A 10-mm trocar was inserted through the umbilical incision into the peritoneal cavity, and the abdomen was inspected by using a 30-degree laparoscope. Two additional 10-mm trocars were inserted through the previously created li-

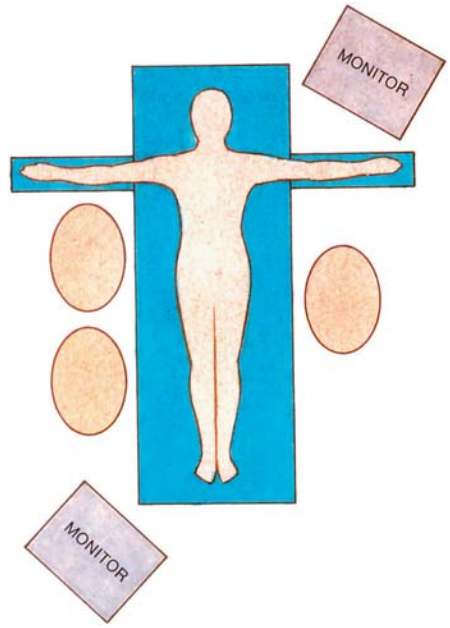

Fig. 14.1. Surgical positioning of the patient for intracorporeal abdominoplasty. Two monitors are helpful if more than one person performs the procedure. Assistants are not required

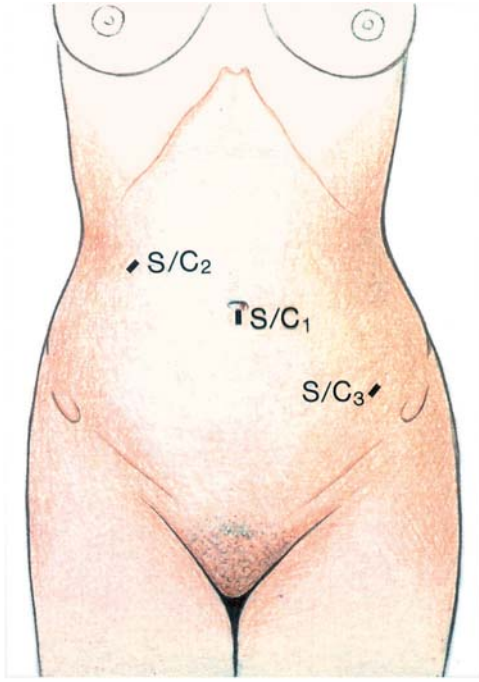

Fig. 14.2. Placement of 1-cm incisions for liposuction and laparoscopic port access (*C*, camera placement; *S*, liposuction cannula placement)

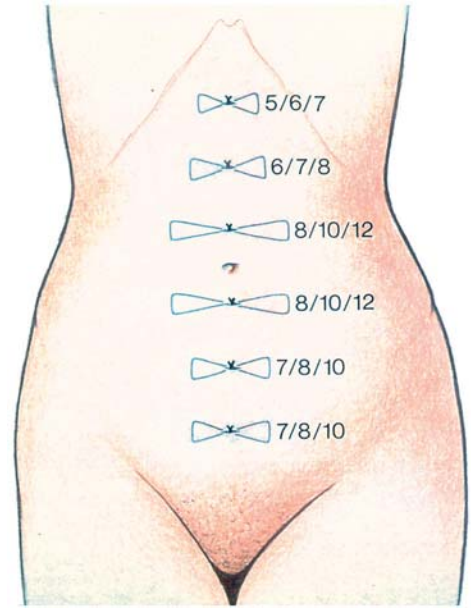

Fig. 14.3. Position of horizontal mattress plication sutures measured from the midline in centimeters

posuction incisions in the right upper quadrant and left lower quadrant under direct visualization. If any adhesions were present, they were "taken down" sharply with endoshears or the electrocautery endoscopic hook Bovie until the posterior aspect of the anterior abdominal wall was free from the costal margin to the pubis.

The midline was marked from xyphoid to pubis, and the border of the diastasis was marked either before or after insufflating the abdomen. Optimal plication ranged from 1.5 to 3 cm on either side of the midline at the xyphoid process and pubic symphysis and from 3 to 4 cm on either side of the midline at the umbilicus. Initially, plication distances ranged from 2.5 to 6 cm lateral to the midline (Fig. 14.3). Sutures were placed 1 – 2 cm apart vertically along the diastasis. A series of 2-mm midline nicks were created in the skin with a no. 15 blade the midpoint of the planed plication suture. Through these incisions a series of horizontal mattress sutures (range 6 – 12 sutures) were introduced into the abdomen using a modified Karl Stortz fascial defect closer to plicate the diastasis (Catalog #26173). A 2 – 0 nylon suture was placed into the modified jaws of the instrument and introduced into the midline nick. The instrument and suture were then tunneled subcutaneously in a lateral direction to the marked edge of the diastasis. This suture was passed into the peritoneal cavity and released. It was then regrasped and withdrawn through a separate fascial stab lateral to the edge of the marked rectus diastasis with the suture passer (Fig. 14.4). The suture was retrieved through the same midline nick. The suture was then passed to the opposite side subcutaneously and reinserted into the peritoneal cavity at the opposing marked position on the skin and released. The suture was retrieved again from the abdomen through a separate fascial stab and withdrawn subcutaneously into the original midline nick (Fig. 14.4). A hemostat was placed on the suture outside of the abdomen. This created a horizontal mattress plication, which traversed a medial portion of the rectus muscle from the peritoneum to the subcutaneous tissue (Fig. 14.5). The suture will invaginate the underlying tissue into the intra-abdominal cavity when tied, thus plicating the rectus and reinforcing the abdominal wall (Fig. 14.5). All sutures were placed before tying them. In selected patients, two lateral sutures were placed 10 – 12 cm off the midline between the costal margin and the iliac crest. The goal was to achieve more of an hourglass shape at the waist as described by Lockwood [33, 34]. After all sutures were placed, the abdomen was desufflated of CO_2, and the midline port was removed. The patient must be under complete neuromuscular blockage for passing and tying the sutures. If a suture is broken inadvertently during the plication, the abdomen is reinsufflated, and the suture is replaced as previously described. After completion of the plication, the abdomen is reinsufflated and inspected through the remaining ports to ensure that bowel or omentum is not "caught up" in the plication. A well-defined midline invagination should be seen. At this time, the remaining

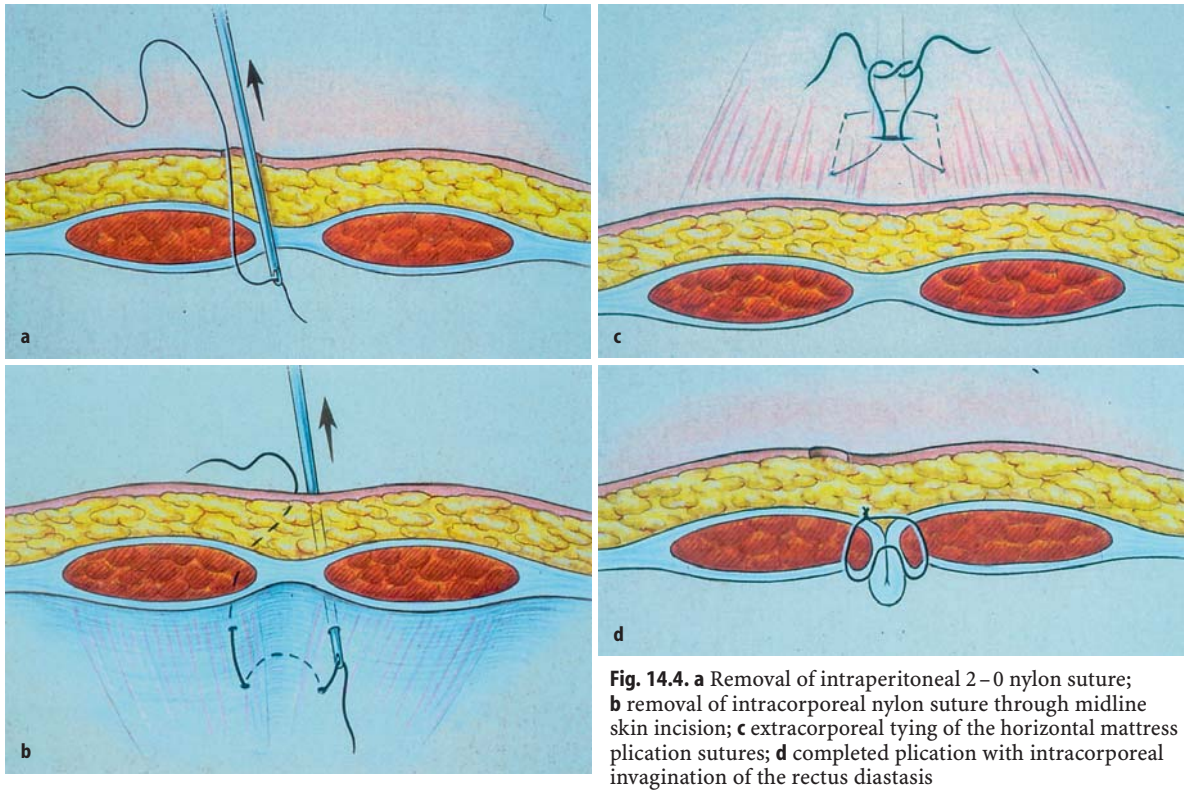

Fig. 14.4. a Removal of intraperitoneal 2 – 0 nylon suture; **b** removal of intracorporeal nylon suture through midline skin incision; **c** extracorporeal tying of the horizontal mattress plication sutures; **d** completed plication with intracorporeal invagination of the rectus diastasis

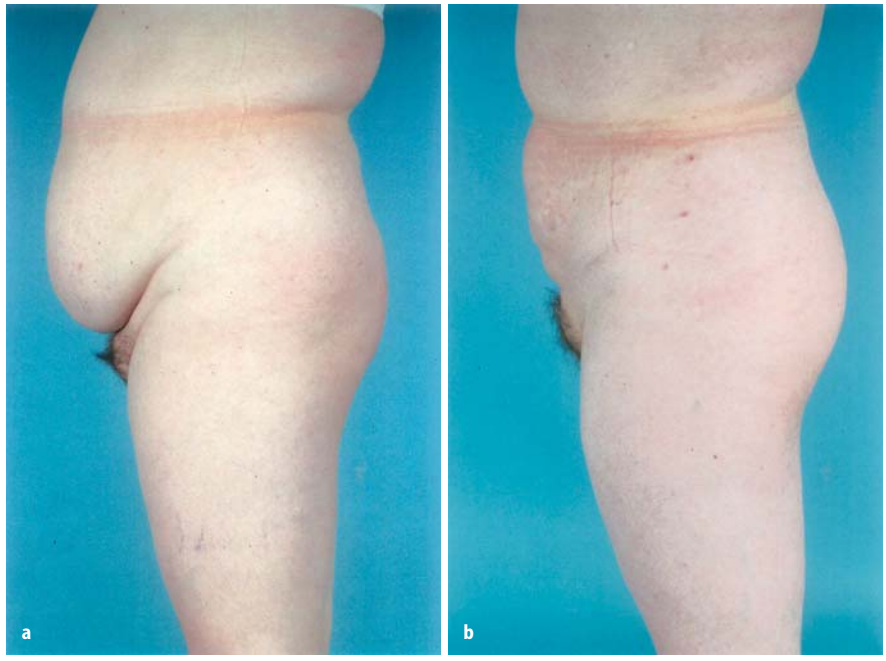

Fig. 14.5. a Preoperative 34-year-old female; **b** postoperatively following intracorporeal abdominoplasty followed by intervening liposuction

laparoscopic ports are removed under direct visualization, and the 1-cm incisions for the ports are closed. The anterior abdominal wall was redraped manually or undermined with liposuction cannulas to remove dimpling caused by the underlying plication. Midline and lateral skin nicks were closed with Steri-Strips. Gauze was placed over the incisions, and either Reston or Topifoam with two abdominal binders was applied. The binders were placed under tight tension. Drains were not used.

The patients recovered in hospital overnight. The epidural anesthetic was discontinued in the morning of the first postoperative day. Foley catheterization was discontinued later. Diazepam (Valium) 5–10 mg by mouth was given to the patient every 8 h during the hospital stay. The abdominal dressings were removed, and the gauze and foam were reapplied under the binders with tight pressure.

The patients were discharged late the first postoperative day with instructions for minimal activity during the next 10–14 days. Discharge medications for the patient included diazepam (Valium) 10 mg by mouth every 6–8 h and one to two oxycodone/acetaminophen (Tylox) tablets by mouth every 4 h as needed for pain. On postoperative day five, methocarbamol (Robaxin) 500 mg by mouth every 6 h and ibuprofen (Motrin) 800 mg by mouth every 8 h were initiated. Diazepam and oxycodone were tapered after 2 weeks, and the patient maintained on methocarbamol (Robaxin) for muscle spasms and ibuprofen (Motrin) for pain and inflammation as needed. Strict instructions were given to wear the abdominal binders at moderate to tight pressure continuously for 21 days, at which time it is recommended that the patient switch to a formfitting garment such as a girdle or Spandex.

The patient was given Eucerin emollient cream and instructed to perform vigorous massage to the anterior abdominal wall and flanks on a daily basis in an attempt to avoid desiccation and intertriginous changes of skin. Close outpatient follow-up is a necessity. The majority of patients return to work after 14–21 days. The patient may experience intermittent muscle spasms in the postoperative period for up to 6 months. In addition, a few patients may experience intermittent hyperesthesia of the abdominal wall of neurogenic origin, which may not manifest until the third or fourth postoperative month and resolve with time. This neuralgia may be related to entrapment or irritation of the intercostal cutaneous nerves in the rectus fascia by the plication sutures. Reducing the distance of plication off of the midline reduced this problem.

14.3 Results

Postoperative satisfaction rate after the surgery for this study period is 94 percent (80 of 85 patients). No intra-abdominal complications occurred requiring operative intervention or celiotomy during the procedure. The average length of surgery from infiltration of tumescent solution to wound closure is 127 min and has ranged from 65 to 243 min. The average amount of liposuction aspirate is 1,886 cc, ranging from 400 to 4,550 cc, with includes the fat and infranatant. The average length of liposuction is 41 min (range 15–77 min). The average length of laparoscopic rectus plication is 51 min (range 18–150 min). Twenty-three patients (27%) required laparoscopic adhesiolysis of the omentum or small bowel from the parietal peritoneum along the anterior abdominal wall to complete the plication. No drains have been used to date, and no patient to date has required more than a one-night hospital stay. Complications to this point have been the following: one case of epidermolysis, two cases of full-thickness skin loss, one wound infection, three cases of prolonged neuralgia (two of which resolved by 6 months postoperatively) and six seromas (30–150 cc). This produced an overall morbidity rate of 15% (13 of 85 patients). All complications were managed on an outpatient basis except for one case of full-thickness loss of tissue (4×1.5 cm). This patient was noncompliant in using the abdominal binder and failed to return for early postoperative appointments because of an unexpected deployment. A seroma developed and went untreated, which led to the overlying skin necrosis.

Three patients developed prolonged hyperesthetic neuralgia. Two of these patients required pain service consultation as outpatients. The hyperesthesia generally developed 3–4 months postoperatively. One of the patients had resolution of symptoms spontaneously. Two patients' symptoms resolved after 2 months of pain clinic consultation with intercostal nerve blocks [35].

Five of the six seromas were managed effectively by outpatient aspiration and compression garments. One patient desired and underwent an open abdominoplasty to correct redundant skin that was persistent postoperatively. She was judged preoperatively to be a poor candidate for the laparoscopic approach but she wanted to minimize scars with the procedure. There is no substitute for good preoperative judgment on the part of the surgeon with this technique because patients will always push for the procedure that minimizes scars.

14.4 Discussion

The endoscopic abdominoplasty has been combined effectively with other laparoscopic procedures with no increased morbidity. This spares the patient a second operation. At present, three laparoscopic cholecystectomies, two bilateral tubal ligations, and one laparoscopic Nissen fundoplication have been performed in combination with the laparoscopic abdominoplasty.

These data were compared with those of 25 abdominoplasty patients undergoing a traditional full open technique with plication of the anterior rectus fascia between May 1993 and February 1997. These patients were women ranging in age from 26 to 55 years (average 35 years). The average length of surgery was 149 min (range 90–230 min). Average hospitalization was 3.1 days. This length of stay may not reflect adequately the civilian experience. In the military, patients are allowed longer hospital stays because of operational concerns, unlike the civilian sector, where most open abdominoplasties are 23 h stay procedures. All open procedures had two drains placed postoperatively. Complications included the following: one postoperative ileus lasting 1 week, one full-thickness skin loss, one wound infection, one wound separation, one wound protuberance requiring operative revision, and one postoperative hematoma requiring surgical drainage. This resulted in a morbidity rate of 24% (6 of 25 cases). Four cases required return to the operating room, and all of these complications extended the hospital stay. Although these comparisons fail to show a statistical difference, clear trends are evident.

Ideal candidates for this procedure were considered to be patients with a large rectus diastasis and moderate to significant abdominal and flank lipodystrophy. Patients with significant epidermal atrophy and loss of skin elasticity as evidenced by thin skin and numerous stretch marks were avoided. We were concerned about the inability of the skin to fully contract after the liposuction component of the procedure. Initially, only patients who had not had previous abdominal surgeries were chosen for the procedure. However, as experience with the procedure grew, more difficult cases were selected. A direct correlation of internal adhesions with previous abdominal surgeries was not found. However, in patients with previous abdominal procedures, one must anticipate a higher probability of encountering adhesions. All adhesions encountered during our series were safely "taken down" laparoscopically by the assisting general surgeon. Skin contracture after aggressive liposuction was apparent even on large-volume aspirates. The degree of contraction of skin made skin excision unnecessary.

The evolution of this technique into its current form started with the plication of both the anterior and posterior rectus fascia with vertical mattress sutures and intracorporeal knots (Fig. 14.6). The plication was changed to external knots on the third case because of the greater ease with which the plication could be accomplished. By the eighth case, horizontal mattress sutures were used to perform the plication because these sutures produced a more complete plication, similar to that seen when general surgeons close the abdominal midline after celiotomy. A number of different sutures were used initially (1-0 and 0 Prolene, 1–0 and 0 Mersilene, 1 and 2 nylon, and 1 Ethibond). By the tenth case, a permanent choice of 2–0 nylon was made because of its strength, ease of handling, and monofilament nature. The first series of lateral plications were performed in June 1996, and a total of 13 lateral plications have been done to date on selected patients.

Most of our patients have some degree of striae formation on the anterior abdominal wall. When possible,

Fig. 14.6. a Preoperative 34-year-old female with abdominal wall laxity and significant diastasis recti; **b** eighteen months postoperatively following intracorporeal abdominoplasty

these patients are treated with the 585 nm pulsed dye laser at a fluence of 3.0 J/cm^2 before surgery and are given two additional treatments postoperatively at 6-week intervals [36]. This, coupled with a topical regimen of 20% glycolic acid applied to the striae each morning and 0.05% tretinoin applied topically each evening, produced significant improvements in striae appearance [37]. These treatment regimens (laser and topical therapy) have been shown to increase the quality and quantity of elastin in the skin, which may be partially responsible for some of the skin contracture seen in our patients. The endoscopic intracorporeal abdominoplasty is designed as a procedure to accommodate the needs of all patients with abdominal wall lipodystrophy and rectus diastasis who would benefit from an open abdominoplasty. Patients who demonstrate particularly lax skin with little subcutaneous fat, or who have particularly severe stretch marks, are poor candidates for this technique. Five of the six seromas and both of the full-thickness skin losses in this series occurred in patients with this type of skin. Although the final result may be acceptable, these patients are not optimal candidates and will benefit more from skin excision combined with diastases repair from a traditional open approach. However, for the vast majority of patients who are suitable for either full open abdominoplasty or one of the mini-abdominoplasty variants, the endoscopic intracorporeal abdominoplasty provides a safe and effective alternative with greatly reduced abdominal incisions and good aesthetic results.

Concerns have been expressed to the authors both about entering the peritoneal cavity to perform an elective procedure and about plicating the medial edge of the rectus muscle, thus making it unstable for later use as a flap. There has been no evidence of permanent damage to the rectus muscle with this technique. Although the laparoscopic abdominoplasty may complicate the later use of the rectus muscle for flaps, traditional open abdominoplasty disconnects both subcutaneous tissue and skin from rectus fascia, also preventing use of a transverse rectus abdominus musculocutaneous (TRAM) flap for reconstructive purposes. Certainly with the laparoscopic technique there is increased opportunity for complications based on the proximity to visceral structures. However, 2 years of experience with this technique has failed to demonstrate a single visceral complication, and there has been no major systemic morbidity and no patient has died. The ninth patient in our series underwent an emergency celiotomy through a lower transverse abdominal incision secondary to bleeding encountered during an elective transvaginal hysterectomy. She had undergone a laparoscopic intracorporeal abdominoplasty 1 year previously. No adhesion formation was noted, and the observation from the operative surgeon was that of an increased thickness to the anterior abdominal wall with intact no. 2 nylon sutures in place.

Skin complications associated with this technique consisted of seroma (7%), postoperative neurogenic pain (4%), skin loss (2%), and wound infection (1%). This certainly compares favorably to the literature reviewing complications associated with liposuction or abdominoplasty [38–42]. These authors have reported rates of seroma at 7%, skin loss (6%), wound infection (6%), and long-standing postoperative pain (3%). In addition, major morbidities such as pulmonary embolus, fat embolus, pneumonia, ileus, and myocardial infarction have been reported with liposuction and traditional abdominoplasty.

The author's experience suggests that the laparoscopic intracorporeal technique of abdominoplasty is safe and effective in our hands with a resultant high degree of patient satisfaction. Whereas the era of minimally invasive, limited-incision surgery has arrived in the field of plastic surgery, this should not necessitate the performance of endoscopy at the cost of patient safety and satisfaction. General surgeons trained after 1991 are highly skilled in laparoscopy, and because general surgeons become plastic surgeons, this procedure should offer no great challenge to their level of training. However, the authors encourage any surgeon who desires to do this procedure to have specialized training in the technique.

In comparison with traditional open abdominoplasty, the surgical scars from the laparoscopic abdominoplasty are significantly reduced. Full-thickness invagination of the rectus diastasis can be accomplished with this technique. The length of surgery and length of hospital stay are decreased with the laparoscopic abdominoplasty, although these differences are not statistically significant. No drains are required, and the morbidity is equal to or less than that with traditional abdominoplasty procedures. The endoscopic intracorporeal abdominoplasty has been developed as a tool to meet the needs of patients with abdominal wall lipodystrophy and rectus diastasis who would otherwise under an "open" abdominoplasty with anterior plication of the rectus fascia. As such, this procedure may become a valuable addition to the armamentarium of the twenty-first century plastic surgeon.

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15 Umbilical Reconstruction in Abdominoplasty

Melvin A. Shiffman

15.1 Introduction

Since the development of abdominoplasty to treat redundant skin and fatty tissues of the abdomen, there has been a continuing evolution in the performance of umbilical reconstruction. No single type of umbilicoplasty has had completely satisfying aesthetic results although a linear transverse incision or excision of a circle of abdominal wall skin has been most commonly utilized.

Grazer and Goldwyn (1977) [1] surveyed 958 surgeons and found that the complication of umbilical scar contracture in abdominoplasty patients was noted "sometimes" by 45 % of surgeons, "always" by 2 %, and "never" by 44 %. The type of umbilicoplasties used in each case was not described.

15.2 Technique

The author utilizes an inferior inverted V resection of the umbilicus (attached to the pedicle) that is sutured to an inverted U incision in the abdominal wall. The umbilical pedicle is shortened with 2 – 0 or 3 – 0 Ethibond or nylon suture avoiding sutures at the inferior portion to be resected (Fig. 15.1). An inverted U is drawn at the place determined where the umbilicus is to be brought through the abdominal wall skin (Fig. 15.2). Point A and point B are approximately 1.5 cm from the midline. Point C in the midline is approximately 1.5 – 2.0 cm superior to points A and B. The inverted U is incised and dissection continued through the subcutaneous fat. Some fat may be resected if there is a tight fit for the umbilical stalk.

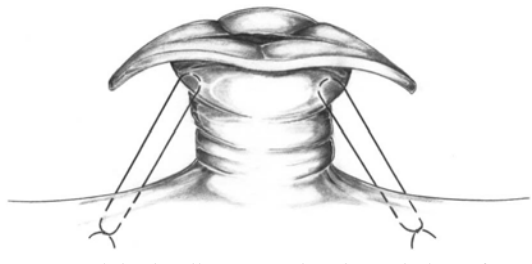

Fig. 15.1. Umbilical stalk is sutured to the underlying fascia in order to shorten the pedicle

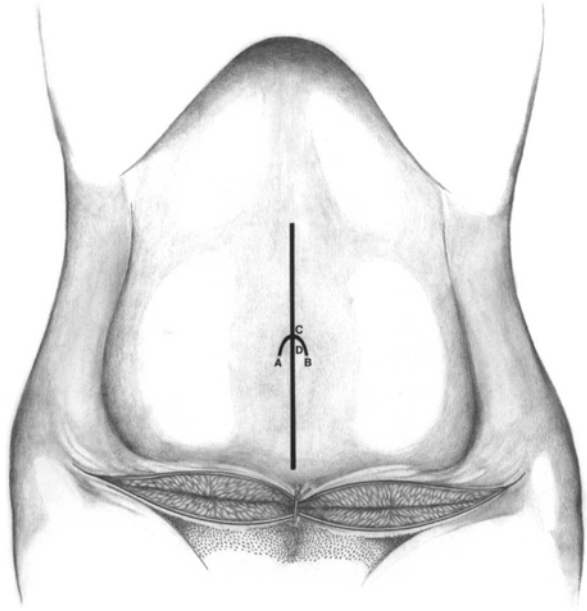

Fig. 15.2. Marking the abdominal wall with an inverted U

The umbilicus is prepared by resecting a V at the inferior portion. Point A1 and B1 are approximately 1.0 – 1.5 cm from the midline (Fig. 15.3). Point D1 is approximately 2.0 cm from A1and B1 and close to the base of the umbilical pedicle. The umbilical skin is brought through the abdominal wall opening. Point C is then sutured with 4 – 0 subcuticular Vicryl suture to point C1, point A to point A1 and point B to point B1 (Fig. 15.4). Point D at the inferior abdominal wall flap is sutured to point D1. It is sometimes easier to place long strands of Vicryl suture with the needle still attached through A1, B1, C1, and D1 and bring the both ends of the suture through the abdominal wall opening before bringing the umbilicus through the opening. The remaining portions of the umbilicus and abdominal wall are then approximated with interrupted subcuticular 4 – 0 Vicryl and the skin closed with interrupted 5 – 0 nylon suture.

The result of the maneuver is to break the circle of scar, cause tension on the inferior aspect of the umbilicus, and allow a hooded effect to the superior portion of the umbilicus (Fig. 15.5).

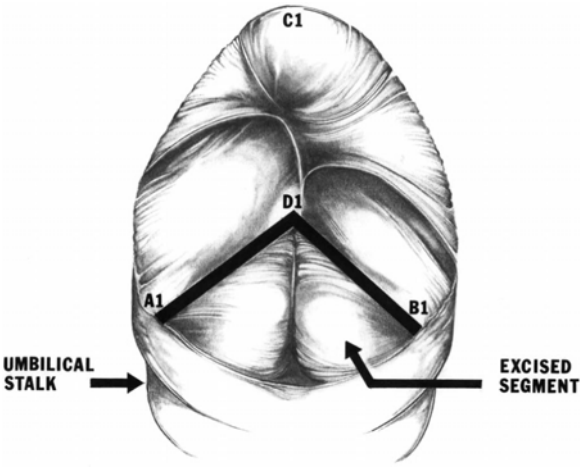

Fig. 15.3. Resecting an inverted V-shaped wedge from the umbilical skin

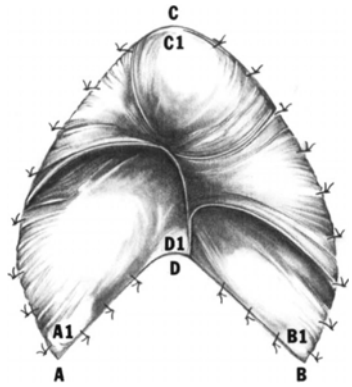

Fig. 15.4. Suturing the umbilicus to the abdominal wall

This method, with an inferiorly based resection of the umbilicus, has consistently good cosmetic results (both surgeons and patients agree). A vertical incision in the inferior umbilical skin, in comparison, results in irregularities from excessive skin on the umbilical side. Scars can be well hidden and do not become hypertrophic or contracted unless the closure dehisces. When the inverted U abdominal wall incision was utilized with a round umbilicus (no incision or excision) the results were similar to using a transverse incision or circular excision of the abdominal wall skin. There were problems with visible thickened scars and contraction of the circular scar with stenosis and, at times, umbilical irritation with odorous discharge.

15.3 History

The search for the most aesthetically pleasing reconstructed umbilicus in abdominoplasty continues. The multitude of techniques varies with the type of abdominoplasty performed (depends upon the method of tissue resection and the resultant scars).

Dubou and Osterhout (1978) [2] described their findings of the position in 95% of the average adult to be at the level of the iliac crests.

Kelly (1910) [3] resected the central portion of the abdominal skin transversely resulting in complete loss of the umbilicus. Gonzalez-Ulloa (1961) [4] placed a circular excision of skin in the abdominal wall for the umbilicus. Galtier (1962) [5] performed vertical and horizontal skin excisions leaving a 3-cm-diameter umbilical stalk with horizontal and vertical scars in the abdominal wall. Grazer (1973) [6] described the use of a 1–1.5 cm transverse abdominal wall incision to which the umbilical stalk was sutured. Baroudi et al. (1974) [7] excised a circle of skin and shortened the umbilical

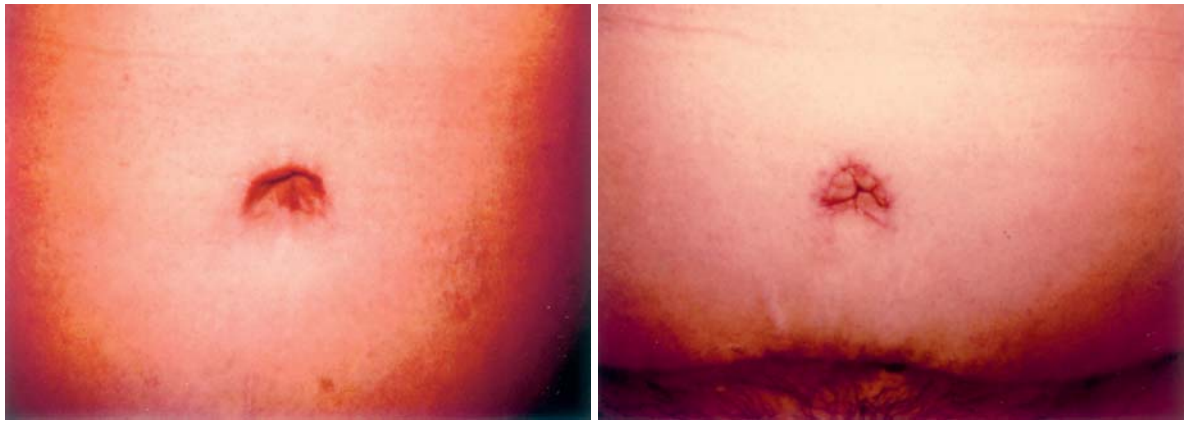

Fig. 15.5. a Final result with inverted V-shaped resection. **b** Umbilicus closed with an inferior vertical incision (not excision) in the umbilicus and inverted U-shaped incision in the abdominal wall. Note the pleating effect in the excessive umbilical skin

pedicle. Regnault (1975) [8] preferred a 2-cm transverse incision for the newly situated umbilicus. Pitanguy (1977) [9] utilized a U-shaped skin incision for the umbilical placement. Kirianoff (1978) [10] described a technique to form a new umbilicus when none exists. Planas (1978) [11] excised fat and skin in the abdominal wall for the new umbilicus. Apfelberg et al. (1979) [12] offered two methods of umbilicoplasty to correct umbilical deformity. The first method required a 2-cm disc of skin to be left attached to the pedicle that was then imbricated by a loose purse-string suture and anchored in a depressed position by suturing the disc to the rectus fascia. The second method utilized a superior-based skin flap, cutting out areas of the surrounding skin in a batwing fashion, and then suturing the skin flap to the defect creating a semicircular scar with two radial extensions. Juri et al. (1979) [13] elected to use a V-shaped skin incision for placement of the umbilicus. Delerm (1982) [14] described the use of a superior-based skin flap and a superior vertical incision in the umbilical skin. The skin flap was sutured into the vertically created defect in the umbilicus.

Faivre and Benelli (1991) [14] utilized a "round block" de-epithelialization of skin around the umbilicus for a deformed umbilicus from umbilical hernia or folds and umbilical striae. The defect was closed with a purse-string suture. Lim and Tan (1996) [15] removed the umbilicus during abdominoplasty and reformed the umbilicus with the skin of the abdominal wall. Opposing triangles were excised from the skin and the flaps sutured to the underlying deep fascia to hide the scars. Rish and Prado (1999) [16] excised a V portion of the superior aspect of the umbilical skin and sutured this to a U incision in the umbilical skin with good results.

15.4 Revision of the Stenosed Umbilicus

In the presence of umbilical stenosis, the umbilicus is contracted and pulled inward (Fig. 15.6). There may be associated irritation and odorous retained secretions in the umbilicus.

Revision of the umbilicus requires careful and thorough cleansing inside the umbilicus to prevent postsurgical infection. The skin is prepped with betadine gel. All of the scar is excised around the umbilicus and excess subcutaneous fat removed. Extending the lateral aspects of the opening in the abdominal wall inferiorly on each side allows an inferior based flap to be formed (Fig. 15.7). Excess skin is excised to form a smooth curved skin edge of the inferior flap. A straight incision is made into the central inferior portion of the umbilical skin extending down almost to the underlying fascia. The pedicle of the umbilicus is sutured to the fascia

Fig. 15.6. Contracted umbilical scar with stenosis

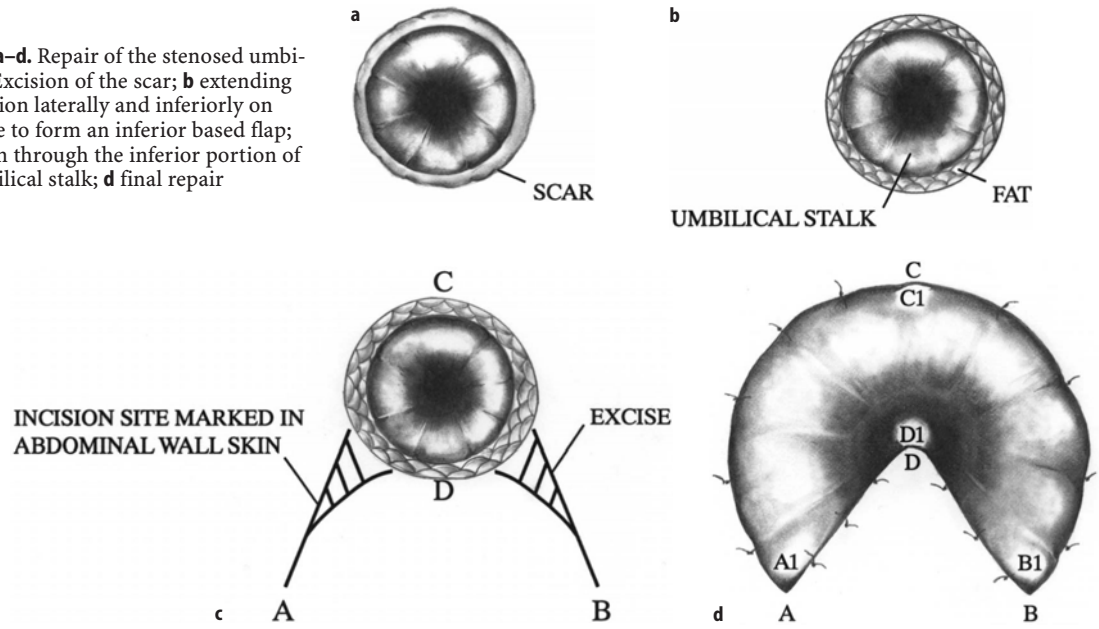

Fig. 15.7a–d. Repair of the stenosed umbilicus. **a** Excision of the scar; **b** extending the incision laterally and inferiorly on each side to form an inferior based flap; **c** incision through the inferior portion of the umbilical stalk; **d** final repair

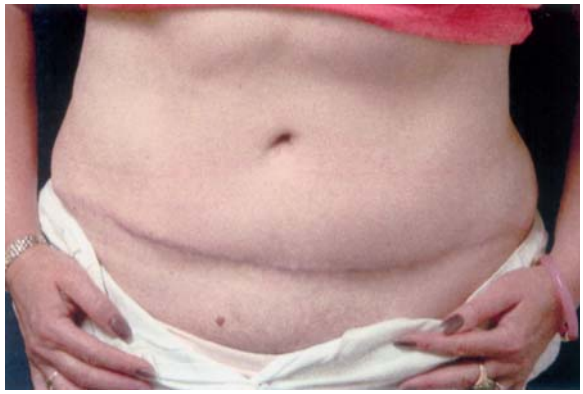

Fig. 15.8. Result after 3 months

with 3 – 0 nylon holding the split ends laterally on each side. The abdominal opening is sutured to the umbilicus, inserting the inferior flap into the incised portion of the umbilical stalk, with subcuticular 4 – 0 Vicryl and the skin closed with interrupted 5 – 0 nylon (Fig. 15.8).

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16 Prevention and Management of Abdominoplasty Complications

Melvin A. Shiffman

16.1 Introduction

Complications following abdominoplasty can occur at any time with any patient despite adequate surgical technique and patient care. These problems may cause patient discomfort, delay recovery, require further surgery, or threaten the patient's survival. The surgeon should be aware of the possible complications, their prevention, their timely diagnosis, and their treatment. The possible risks and complications must be discussed with the patient prior to surgery.

16.2 Complications

16.2.1 Asymmetry

If care is not taken in the initial marking prior to surgery, asymmetry may result. The midline should be marked above the umbilicus and in the area of the pubis. If there is a very fatty abdominal wall, the midline at the level of the pubis can be located either by visualizing the anterior junction of the vulva or carefully spreading the pubic hair to find the direction of the hairs that diverge to each side at the midline.

The transverse lower abdominal incision line should be marked preoperatively so that the distance from the midline is equal on each side. The height of the ends of the lateral extensions should be equidistant from some measurable point superiorly or inferiorly, such as the anterior superior tubercle or the level of the top of the ilium.

The amount of skin excised is determined by firm traction on the skin flap at an equidistant point on each side from the midline of the flap. This will prevent excessive tension on one side of the flap compared to the other.

Care must be taken to center the umbilicus to prevent asymmetry involving the umbilicus.

Excessive fat or skin can be surgically excised to correct asymmetry. Fat can also be liposuctioned in areas of excess.

16.2.2 Bleeding (Bruising, Hematoma, Exsanguination) [1 – 3]

The presence of bruising following any surgical procedure is accepted as a known consequence of the procedure. When a swelling filled with blood appears in the abdominal wall shortly after surgery, the surgeon must make a decision as to careful observation or some form of drainage. When a hematoma first appears, the clot can be aspirated only with great difficulty. Over time (a few days) the fibrin precipitates and the remaining fluid can be more easily aspirated with a needle. If the hematoma is not aspirated, the serosanguinous fluid in the pocket will slowly become typical serous fluid and thus a pseudocyst. When the hematoma is increasing in size, surgery should be seriously considered to ligate the bleeder surgically by exploring the wound and emptying the clot. Mohammad [3] reported a 9 % incidence of hematoma.

Bleeding from the wound is easier to monitor than hidden bleeding. Compression dressings, bed rest, and ice packs sometimes will control the bleeding. If there is persistent bleeding, surgical exploration is essential. The wound is opened, any hematoma evacuated, and the bleeder(s) ligated or electrocoagulated. The wound may be closed with or without drainage but it is safer with catheter or Penrose drainage.

The presence of orthostatic hypotension should be a warning that there may be inadequate fluid replacement or excessive blood loss. Fluid should be replaced if the hypotensive episodes persist. If there is no prolonged response, then there is probably excessive blood loss even if there is no apparent bleeding from the wound or expanding hematoma. Immediate hemoglobin (Hgb) and hematocrit (HCT) should be obtained and if there is a significant drop from the preoperative studies, then replacement of fluids should be rapid with volume expanders such as Hespan or albumin. A 20 % drop in Hgb or HCT is reason enough to consider blood replacement since these studies do not equilibrate for 24 – 48 h. Admission to a hospital emergency room may be necessary to monitor the patient over a period of time in order to determine if blood replacement is necessary.

16.2.3 Dehiscence [1, 4]

Dehiscence following abdominoplasty usually occurs at the tightest point of the abdominal incision closure. This point is the center of the flap at the attachment in the region of the pubis. The area darkens and necrosis occurs followed by disruption of the closure, sometimes with the wound pulling apart. The tight closure elongates the vessels resulting in spasm and clotting of the vessels, which is followed by necrosis and disruption of the wound. Usually the wound does not pull far apart because the sutures lateral to the disrupted area hold the wound together.

Other contributory causes include smoking, poorly controlled diabetes mellitus, underlying hematoma or seroma, and too much activity by the patient. Many surgeons close the wound tightly with the patient bent tilting the chest and legs toward each other. The surgeon then expects the patient to remain in that position for several weeks even while walking around. Compliance with these instructions is usually poor since it is virtually impossible to maintain this position for any length of time, especially if the patient has a history of back problems.

Treatment for dehiscence should be conservative allowing the wound to slowly slough the necrotic tissue and the wound should heal by secondary intention if the wound cannot be sutured closed because of excessive tension. The necrotic tissue can be debrided at appropriate intervals of time. Usually the scar will contract sufficiently to form a slightly widened scar that can be revised if necessary (if the patient is dissatisfied with the appearance).

16.2.4 Dog-ears

The closure of the transverse lower abdominal wound is started with a suture in the midline to properly position the new umbilicus. The wound should then be closed starting laterally on each side to give a flattened appearance to the most lateral regions of the wound. If there is excessive fatty tissue in the region where dog-ears usually form, this tissue should be excised prior to the closure.

Many times small dog-ears will resolve within 3 months without treatment. When there are persistent dog-ears for more than 3 months, these can be excised under local anesthesia, usually in an elliptical form. Very large dog-ears and fullness in the area can be treated by liposuction as well as excision.

16.2.5 Edema, Persistent

When edema is persistent, over 3 months, and does not respond to conservative measures such as compression, liposuction with tumescent solution should be considered. Too much liposuction may result in damage to the skin or indentations. Therefore, the liposuction should be conservative. At the same time there should be a determination as to whether there is persistent edema or just too much residual fat.

16.2.6 Infection, Sepsis [1]

Wound infection is a known consequence of any clean surgery, occurring in 1 % of patients in an outpatient or office surgical center and 3 % in a hospital. It is not unusual for slight erythema to occur around the sutures without actual significant infection. If significant wound erythema occurs while the patient is on antibiotics, the dosage may be increased or the antibiotic changed. The wound should be watched very carefully for progression of the infection that may require intravenous antibiotics that can be given as an outpatient of the hospital. Infections not responding to antibiotics may require consultation with an infectious disease specialist and may indicate early necrotizing fasciitis or may evolve into toxic shock syndrome that can be fatal. Complete blood count (CBC) should be obtained as well as wound, where possible, and blood cultures

Uncontrolled infection can be life threatening if sepsis occurs. This may be indicated by fever, elevated white count, and lethargy. Prompt treatment with appropriate intravenous antibiotics is essential.

16.2.7 Necrosis [1, 2, 4]

Necrosis is more likely to occur if the patient is a smoker, if concomitant abdominal liposuction is performed, or if there has been prior extensive liposuction to the abdominal wall. Smokers may say they will stop smoking but there are some who will continue to smoke despite all the admonitions. There is nothing that can be done if the patient does not stop smoking completely. The necrosis will progress to its fullest extent, not only in the lower abdomen, but also at times in the periumbilical area and upper abdomen.

Poorly controlled diabetes mellitus, very tight wound closure, underlying hematoma or seroma, and infection may contribute to the cause and extent of the necrosis. If the patient has a prior transverse upper abdominal scar (i.e., cholecystectomy, gastrectomy, splenectomy), the triangle formed by the scar, the midline, and the tightly pulled abdominal skin flap is suscepti-

ble to necrosis unless enough space is left between the old scar and the transverse closure line to allow vascularity to the triangle. It is helpful to place less tension on the flap closure so that stretching the vessels and thromboses are not added to the problem. Sometimes, the use of a different type of resection may be necessary to prevent necrosis. This usually means the addition of a vertical midline scar [5].

The best treatment is observation with debridement as needed and allowing the wound to heal by secondary intention. Placing skin grafts in a granulating abdominal wound will shorten the healing time but will not allow the wound to contract enough to decrease the extent of scarring. It is surprising how small the scar can be after complete healing and contraction even if the whole lower abdominal wall has been involved with necrosis. Scar revision is usually necessary for wide or irregular scars.

16.2.8 Necrotizing Fasciitis

Necrotizing fasciitis is a result of infection from *Streptococcus* or mixed infection, frequently with anaerobic organisms. The infection results in thrombosis of the subcutaneous vessels including vessels entering the fascia and underlying muscles. The tissues become necrotic and require debridement as well as proper antibiotics. Cultures of the tissues may reveal the offending organism(s). The wound should then be allowed to granulate and can be skin grafted when all the necrotic tissue has been removed.

16.2.9 Need for Further Surgery

There are a variety of reasons for further surgery being necessary following abdominoplasty. These include asymmetry, irregularities, dog-ears, necrosis, inadequate skin resection, significant scar (hypertrophic or keloid), umbilical stenosis, or excessive fat requiring liposuction. If a patient has excessive fat prior to the abdominoplasty and the fat is not liposuctioned at the same procedure, the patient should be informed about the probable future need for liposuction before surgery.

16.2.10 Perforation of Intra-abdominal Viscus

It is possible to perforate the bowel when repairing an umbilical hernia or ventral hernia at the same time as performing the abdominoplasty by not opening the hernia sac to observe for attached bowel or placing the sutures superficially only in well exposed fascia. Closing the midline fascia in a patient with a very loose abdominal wall may require sutures at the lateral edge of the rectus. This is an area consisting only of fascia and peritoneum millimeters in depth where suturing can readily perforate into the abdominal cavity. It might be more appropriate to consider lateral sutures in the external oblique aponeurosis first before central repair so that the central sutures may not need to be placed so far laterally.

Any patient complaining of more postoperative abdominal pain than the usual patient or persistent severe pain should be observed very carefully and at appropriate short intervals of time to rule out perforation of a viscus. Abdominal X-ray series may be indicated and possibly observation in the hospital.

If a perforation is diagnosed, immediate surgical intervention is indicated. Preoperative antibiotics should be started. The abdomen should be carefully explored for possible multiple perforations and any observed bowel perforations should be closed after thorough irrigation of the abdominal cavity. Early intervention may prevent a severe infectious process.

16.2.11 Recurrent Panniculus

Patients should be forewarned that weight gain after abdominoplasty could result in recurrent fatty abdomen with panniculus that might require another surgical procedure. Pregnancy after abdominoplasty is a risk for causing loose skin, stretching the muscles in the midline, and striae. This may result in the need for repeat abdominoplasty.

16.2.12 Recurrent Protrusion of Abdominal Wall

Some patients have very lax abdominal wall muscles and there is a tendency for recurrent protrusion after a seemingly adequate fascial repair. This can be improved with repeat closure of the abdominal wall fascia in the midline with the combination of lateral wall (external oblique aponeurosis) tightening. This repair can also be performed for the patient who has recurrent protrusion from loosened or disrupted sutures.

16.2.13 Scarring (Widened, Thickened, Hypertrophic, Keloid) [2]

Wide scars are frequent following abdominoplasty because of the need for a tight closure to get a flat abdomen. When the skin loosens after 6 months, it is possible to resect the scar in order to make it thinner.

Certain individuals are prone to get hypertrophic scars although this is unpredictable. Hypertrophic scars may resolve without treatment. Keloid scars occur in 15 % of blacks, Asiatics, and Hispanics. There are a variety of treatments available, usually used in combi-

nation (see Chap. 25). Recurrence of keloids is common.

16.2.14 Sensory Loss [1, 6]

Loss of sensation in the abdominal wall is more common when liposuction is performed at the same time as abdominoplasty. This sensory change is usually temporary and resolves without treatment.

Injury to the lateral femoral cutaneous nerve has been reported [1, 6]. This can result in permanent sensory loss along the anterior, lateral, and posterior thigh. It is possible to explore and reanastamose a transected nerve, if the nerve ends can be found and a large section of the nerve has not been removed. This type of surgery must be performed in a timely manner in order to have any success. Usually the sensory loss is not in areas that will interfere with normal activity and patients may become used to the sensory loss over a long period of time.

16.2.15 Seroma [1–3, 7, 8]

The use of drains following abdominoplasty usually prevents the accumulation of blood but may not prevent seroma formation. The large flap with an empty space extending from xyphoid to pubis is readily filled with serous fluid with patient movement that results in the rubbing together of raw tissues. If there is a palpable fluid collection, this can be aspirated and compressed to allow the tissues to seal. If aspiration does not resolve the problem, injecting room air to fill the cavity after fluid aspiration will almost always result in sealing the cavity. Introduction of air may have to be repeated if there is a larger cavity. This method is less traumatic than excision of the pseudocyst.

16.2.16 Skin Overhanging Scar

If not enough skin is resected in abdominoplasty or the transverse lower abdominal scar becomes adherent to the underlying fascia, there may be a visible overlap of the skin over the scar. This may require revision by resecting the excess skin and/or freeing up the skin scar attachment to the deeper tissue.

16.2.17 Thromboembolism (see Chap. 26)

Thromboembolism is a risk of any surgical procedure over 1 h in length, in patients over the age of 40 years, in patients with a prior history of thromboembolism or family history of thromboembolism, and if estrogen is not stopped prior to and following surgery. Ambulation should be early and intermittent compression garments utilized during surgery especially in patients at risk.

16.2.18 Toxic Shock Syndrome (see Chap. 25)

Toxic shock syndrome is a result of infection with *Streptococcus* or *Staphylococcus* that produces exotoxin resulting in fever and drop in blood pressure as well as affecting multiple organ systems. This is potentially fatal and the operating surgeon should be aware of the need for timely diagnosis and intervention.

16.2.19 Umbilical Stenosis

The advent of a contracting scar around the umbilicus following abdominoplasty is not rare. There have been different methods proposed for doing the umbilical reconstruction during abdominoplasty in order to prevent stenosis (see Chap. 15). The umbilical stenosis may result in chronic inflammation and drainage that the patient needs to have addressed. At the same time, a stenosed umbilicus is not a normal looking umbilicus. Reconstruction of the stenosis can be surgically performed (see Chap. 15).

16.2.20 Umbilicus, Off Center or Loss

The umbilicus should be evaluated for deviation from the centerline preoperatively. If deviation is present, then this should be pointed out to the patient, discussed with the patient, and recorded in the medical record. The deviation may need to be adjusted at the time of surgery. Imbrication of the fascia next to the umbilical stalk on the side opposite the deviation will result in centering the umbilicus.

The centerline of the abdomen must be marked preoperatively. The umbilicus should be brought through the abdominal wall at the appropriate height and in the marked midline. A deviated umbilicus can cause the patient distress and result in litigation.

When performing a modified abdominoplasty without release of the umbilicus, there will usually be deviation of the umbilicus inferiorly from removal of the excess skin. The patient must be informed of this problem preoperatively since the lowered umbilicus may not look normal especially in a bathing suit. The normal umbilicus is at the level of the iliac crests.

When the umbilical stalk is denuded of all the fat during abdominoplasty, the blood supply should not be disturbed since it comes through the underlying fascia. However, if a full abdominoplasty is performed follow-

ing a modified abdominoplasty, where the base of the umbilicus has been transected and the umbilicus lowered, the blood supply may not be sufficient and necrosis of the umbilicus may occur. The physician should be forewarned in a patient who has had a prior abdominoplasty or tummy tuck to look for this possible problem by obtaining the prior surgeon's records.

The smoker is a major source of necrosis following abdominoplasty and this may affect the umbilicus or the periumbilical region. Needless to say, the patient must stop smoking at least 2 weeks prior to surgery and for 2 weeks after surgery. There still remains the problem of the patient who says smoking will be stopped but in actuality the patient continues to smoke. When this information is divulged after surgery to the surgeon or medical staff, there may be difficulties getting the patient to stop smoking even when necrosis is severe. The medical record should be excruciatingly complete with every conversation, phone call, and recommendation.

16.3 Discussion

The combination of liposuction with abdominoplasty is associated with an increase in the risks and complications. Fat embolism syndrome has been reported [9] as well as an increased incidence of thromboembolism. Necrosis is more common, possibly because of injury to the cutaneous vascular system. Wallach and Matarasso warn about the problem with liposuction of the mid upper abdomen at the same time as performing abdominoplasty (see Chap. 6).

Benvenuti [10] reported an increased incidence of inguinal hernias following abdominoplasty. Obesity has been associated with increased complications following abdominoplasty, 80 % in obese and 33 % in non-obese patients [11].

Postoperatively, the surgeon should check the patient at appropriate intervals of time depending on the extent of surgery, patient age, and patient. Awareness of the early symptoms or physical findings of a complication is essential in order to make a timely diagnosis. Proper studies should be obtained and treatment begun as soon as possible in order to avoid a dangerous or life threatening problem.

If a diagnosis of a complication is difficult for the attending surgeon to make, early consultation should be obtained. If the surgeon intends to leave the area for any reason, the patient should be informed and adequate medical coverage obtained. This should be a surgeon who is experienced in performing the same surgery as performed on the patient. Any important or critical patient problem must be relayed to the covering physician and records made available when necessary.

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Avoiding Abdominal Wall Necrosis in Abdominoplasty

17

Melvin A. Shiffman

17.1 Introduction

One of the most devastating complications in abdominoplasty is the occurrence of abdominal wall necrosis. This may involve only the inferior portion of the skin flap or a large section of the lower and upper abdominal wall. The causative factors vary but necrosis can usually, but not always, be avoided. The author has analyzed the causative factors involved in an attempt to aid other surgeons in avoiding this complication.

17.2 Arterial Supply of the Abdominal Wall

Huger [1] divided the abdominal wall vascularity into three zones. Zone I is the area from xyphoid to pubis bounded laterally by the lateral margin of the rectus muscles. Zone II is the area of the lower abdomen from the pubis and inguinal creases to a line at the level of the anterior superior iliac spines. Zone III comprises the area on each side lateral to Zone I superior to a line between the anterior superior iliac spines.

The arterial supply to Zone I superiorly is from the superior epigastric artery originating from the internal mammary artery that is derived from the first portion of the subclavian artery. Inferiorly the supply is from the inferior epigastric artery originating from the external iliac artery. Secondary vessels are from Zone III crossing the midline.

The arterial supply to Zone II is from the superficial epigastric artery and the superficial external pudendal artery both of which are branches of the femoral artery that originates from the external iliac artery and from the superficial circumflex iliac artery that also originates from the femoral artery.

Zone II arterial supply is derived from the intercostal, subcostal, and lumbar arteries that are branches from the aorta.

17.2.1 Smoking

Cigarette smoking is associated with atherosclerotic cardiovascular disease, cancer, and chronic obstructive pulmonary disease. Smoking is a risk factor for arteriosclerosis obliterans and thromboangiitis obliterans. Nicotine activates chemoreceptors of the aortic and carotid bodies resulting in vasoconstriction, tachycardia, and elevated blood pressure. The ultimate response of any one system is the summation of stimulatory and inhibitory effects of nicotine. Small doses of nicotine cause the discharge of catecholamines from the adrenal medulla, but larger doses prevent their release in response to splanchnic nerve stimulation.

The average cigarette contains 8–9 mg of nicotine and delivers about 1 mg of nicotine systemically to the smoker [2]. The intensity of puffing and technique of the smoker can increase the bioavailability of the nicotine [3]. The half-life of nicotine in the smoker is 2 h [2] with 80–90% metabolized in the liver, kidney, and lungs. Even though there appears to be complete metabolization by 24 h, patients who do not begin to stop smoking at least 2 weeks before surgery are likely to continue right up to the time of surgery and after surgery.

The patient who is a smoker is set up for necrosis if smoking is not completely stopped prior to and following surgery. Chronic smokers have difficulty withdrawing and attempts at withdrawal are associated with significant symptoms (Table 17.1). Smoking cigarettes, using oral snuff, chewing tobacco, and chewing nicotine gum result in a peak of nicotine within 30 min

Table 17.1. Symptoms of nicotine withdrawal

1. Irritability
2. Impatience
3. Hostility
4. Anxiety
5. Restlessness
6. Dysphoric or depressed mood
7. Difficulties concentrating
8. Increased appetite or weight gain

Fig. 17.1. a Necrosis of periumbilical area and central lower abdominal wall in a patient who would not stop smoking before and after full abdominoplasty. **b** Following complete healing by secondary intention in 10 months. *Arrows* show areas of scar that are slightly indented and required revision

while the use of the nicotine patch results in a peak in 8 h. Patients who refuse to stop smoking should not have a complete abdominoplasty (Fig. 17.1) and may not be candidates for any cosmetic surgical procedure [4].

Necrosis in smokers may involve the lower and upper skin flap including the new periumbilical area. Destruction of the stalk may also occur.

17.2.2 Liposuction Combined with Abdominoplasty

The combination of liposuction with a full abdominoplasty can have devastating consequences if care is not taken to limit the amount and areas of liposuction and/or the extent of the abdominoplasty. Matarasso [5] describes four types of abdominal wall laxity and presents information on the critical areas of the abdominal wall to liposuction at the time of abdominoplasty. Abdominoplasty may be combined with liposuction if the central upper abdominal area has cautious liposuction and the areas lateral to this central area have limited liposuction. Patients should be screened as to risk factors. Low risk includes young age, low volume of liposuction, and no concomitant intra-abdominal surgical procedures. Moderate risk includes larger extent and multiple sites of liposuction, obesity, and "T" closures. High risk includes prior history of thromboembolism, smoking exposure, and coexistent morbid medical conditions.

Bozola and Psillakis [6] devised a classification of abdominal wall deformities and their treatment. There are a variety of treatments advised for the different deformities. However, the author disagrees with the treatment of type 4 by transecting the umbilical stalk from its attachment to the aponeurosis. There is very little reason to lower the umbilicus except in a minimal fashion to prevent a vertical midline scar. Type 5 deformity is treated with the full abdominoplasty that may be combined with liposuction. There is no mention of the

risks of extensive liposuction done concomitantly with full abdominoplasty.

17.2.3 Liposuction Prior to or Following Abdominoplasty

The question frequently comes up as to which is better, doing liposuction before, during, or after abdominoplasty. Doing liposuction before abdominoplasty allows the fat to be removed from the abdomen and surrounding areas without having to be concerned about injuring the blood supply. However, a recent study has shown that a full abdominoplasty after extensive liposuction may result in severe complications including necrosis. The author's experience has also shown that liposuction first may still result in necrosis (Fig. 17.2) unless the liposuction and/or the abdominoplasty is limited in extent. Also, the liposuction results in intense scarring and makes the abdominoplasty more difficult, trying to separate the fat and subcutaneous tissues from the underlying fascia.

Performing liposuction after abdominoplasty allows the surgeon to be more discriminating in selecting the areas to be treated and any touch up, as for dog-ears, can be done at the same time. Tissue planes are more distinct during abdominoplasty and vessels are more easily visualized for ligation.

17.3 Tight Closure

There is a tendency for surgeons to excise as much lower abdominal skin flap, as well as extending into the upper abdomen (above the umbilicus), in order to obtain as flat an abdominal wall as possible. This can be overdone by stretching the skin as tightly as possible with the patient in a flexed position and then keeping the patient flexed for weeks into the postoperative period. There are very few patients who can tolerate the flexed position for any length of time while attempting to ambulate especially if the patient has a chronic back problem. The author closes the subcutaneous tissues as tightly as possible while the patient is in a flat supine position and then may flex the patient in order to close the skin more easily.

If the skin flap is stretched too tightly, the vessels of the flap may become stretched, spasm, and then clot causing flap necrosis. The necrosis is usually in the central mid-portion of the flap.

17.4 Concomitant Upper Abdominal Wall Scars

The subcostal scar from cholecystectomy or gastric surgery disrupts the vascular supply to the skin flap medial to the scar. When the flap is pulled tightly, the vascular stretching and spasm are complicated by the disrupted blood supply and may result in flap necrosis. The necrosis appears in the triangle between the scar and the midline. This may be prevented by minimizing the amount of flap resected and leaving at least a 4–6 cm space between the inferior point of the scar and the cut edge of the skin flap or by resecting the central portion of the abdominal flap leaving a midline scar [7].

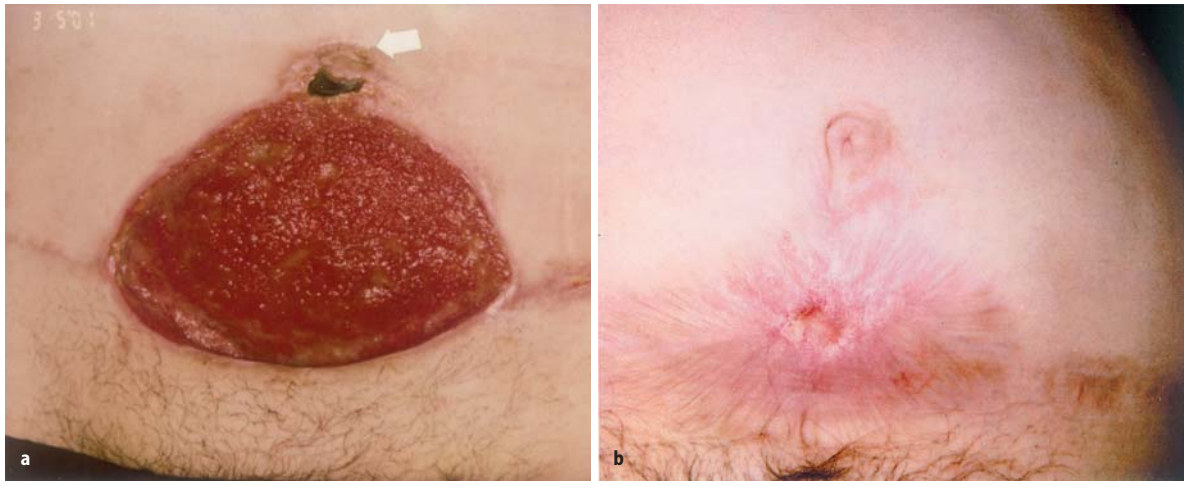

Fig. 17.2. a Extensive lower abdominal wall necrosis in a patient who had extensive liposuction 4 months before having a full abdominoplasty (*arrow* at umbilicus). Cyanotic changes did not respond to the use of Nitro-Bid. The wound 2 months after abdominoplasty shows good granulations. The umbilical stalk is still intact (*arrow*). **b** Wound completely healed by secondary intention after 10 months. Revision of scars will be necessary after maturation of scar in 6–10 months

17.5 Hematoma

The pressure exerted on the abdominal wall skin flap by a hematoma can result in flap necrosis especially if there are other concomitant factors. Care should be taken to obtain hemostasis before closure of the abdominal wall. Even with good hemostasis, it is possible, because of excessive activity, coughing, trauma, or sneezing that a vascular clot may come loose, resulting in bleeding. Recognition and immediate evacuation of the hematoma may preserve the flap.

17.6 Infection

Infection may occur as a result of contamination of instruments or by a break in sterile technique. Statistically, infection occurs in clean, uncontaminated surgical wounds in 3% of hospital cases and 1% of cases in an outpatient office setting. Early recognition and adequate treatment of the infection may prevent flap necrosis.

Necrotizing fasciitis is a result of infection by a fulminant group A streptococcus that starts as a cellulitis, spreads to the superficial and deep fascia, and produces thrombosis of cutaneous vessels and necrosis of the underlying tissues. Other organisms, aerobic, anaerobic, or mixed, may cause the same process. Recognition of this process early in its course will allow debridement and drainage that may limit the extent of the necrosis and avoid mortality.

Diabetes mellitus increases the risk of infection when the blood sugar is not controlled preoperatively and postoperatively. If general anesthesia is utilized and the patient is not expected to eat for a period of time postoperatively, the blood sugar level should be monitored and intravenous or subcutaneous insulin used when necessary. Daily blood sugar evaluation during the time of healing is essential for patients who are on insulin or oral diabetic medications. Patients controlled by diet alone can be controlled postoperatively by resuming the diet as soon as possible. Elevated blood sugar should be treated adequately and promptly. If infection occurs in a diabetic patient, the result is usually elevation of the blood sugar that in turn increases the infectious process problem.

17.6.1 Smoking

Patients who smoke cigarettes just before or after abdominoplasty are highly prone to necrosis of the flap because of the disturbance of the blood supply. It is necessary to strongly advise the patient against smoking, usually for 2 weeks before and 2 weeks after surgery. Some patients are unable to stop smoking because of the symptoms of withdrawal (Table 17.1) and either refuse to stop or say they will cut down. Any smoking at all is hazardous to the skin flap and, therefore, the surgeon must decide whether or not to proceed with the surgery after a thorough warning to the patient. Some patients will say that they will stop smoking and in fact continue to smoke after surgery without telling the physician because they are afraid to be admonished about the smoking. The author does not perform cosmetic surgery with flaps if the patient refuses to stop smoking.

17.7 Discussion

When the tissues become cyanotic and have an increased refill time, over 6 s, the chances of saving the tissue are slight. The author has found that even with the use of Nitro-Bid ointment (Hoechst Marion Roussel, Kansas City, MO) (Fig. 17.2) or other vascular dilators, the necrosis will proceed to its inevitable end. However, the use of these ointments or medications assuages the patient's fears, gives the patient something to do that may be helping the wound, and gives the patient confidence that in time the wound will heal with the treatment. Early cutting of the tight sutures may help but leaves a large defect that will take months to fill in. Since healing of necrotic areas takes weeks to months, the patient needs something positive to do during the period of debridement rather than simply waiting and hoping that the wound will get better. Necrotic tissue should be debrided until there are fresh granulations and the wound kept clean by the patient with frequent cleansing and sterile dressings. The wound can be allowed to close on its own, which may take months, or split thickness skin graft applied. Skin grafts allow faster healing but prevent ultimate contraction of the wound. On the abdominal wall, skin grafts are not usually indicated since secondary healing can result in an acceptable scar in comparison to a skin graft that fills the space with a conspicuous scar and thin skin.

There are no guidelines as to what constitutes a less aggressive liposuction or what constitutes a limited abdominoplasty. Limited liposuction means avoiding the central upper abdomen except for the deep subcutaneous fat and generally avoiding superficial liposuction. Limited abdominoplasty means removal of less skin-subcutaneous fat flap, no tension, less lateral dissection, and less superior dissection. The flap should be limited to the central abdomen halfway across the external oblique aponeurosis from the lateral edge of the rectus muscle and below the costal margins superiorly. Even then there is no guarantee that necrosis will not occur but at least it will be less likely.

17.8 Conclusions

The cosmetic or plastic surgeon should be aware of the possible causes of flap necrosis, their avoidance, and the treatment of the problem.

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18 History of Liposuction

Melvin A. Shiffman

Dujarrier [1], in 1921, attempted closed removal of adipose tissue from the knee and calf with the use of a uterine curette. The femoral nerve was injured and ultimately the patient's leg had to be amputated. In 1964 Schrudde [1] described removal of localized deposits of subcutaneous fat with a curette. Vilain [2], in 1975, proposed curetting of fat through a small incision. Liposuction, for the removal of fat through small incisions using suction, was devised by Arpad and Giorgio Fischer in 1974 [3]. The first instrument, the planatome, had suction and also an electric curette to cut the fat before suctioning. The technique, a dry technique, was described in reports from 1975 to 1977 [4–6]. This was followed by a demonstration of the technique at Fournier's clinic in Paris in March 1977. Illouz, a gynecologist, decided to utilize the existing equipment in the hospital, Karman abortion machine and suction curette, to perform liposuction. Kesselring and Meyer (1978) [7] reported the use of a sharp curette with suctioning of fat but had limited indications for this technique (in the trochanteric area only).

Martin brought the technique of liposuction to the United States in 1980 and Illouz presented the first course on liposuction in the United States in 1981 [1]. Fournier introduced the syringe technique to liposuction using a syringe instead of a machine to aspirate the fat [8–10].

The wet technique, including small volumes of saline to the anesthetic solution, became prevalent reducing blood loss slightly, but Klein's (1987) [11] technique of tumescent local anesthesia for liposuction reduced bleeding to almost 1 % of the aspirate compared to 30 % with the dry technique. Actually, the use of tumescent anesthesia, including the use of infiltrators for massive infiltration analgesia (Rudolph Matas' infiltrator, Farr's local anesthesia injector), has been described previously in various textbooks and papers since 1924 [12–15].

Illouz (1985) [16] proposed the technical principles for liposuction (Table 18.1) and in 1989 [17] the Ten Commandments of Adipoaspiration (Table 18.2). Fournier (1991) [18] proposed the Ten Commandments of the Liposculptor (Table 18.3). Liposuction has developed into one of the most commonly performed cosmetic surgical procedures.

Table 18.1. Technical principles of liposuction

1. Use blunt instruments
2. Create many tunnels
3. Dissecting hydrotomy is useful
4. Operate deeply
5. Conceal the scar
6. Use the retraction of the skin

Table 18.2. The Ten Commandments of lipoaspiration

1. Create only tunnels
   a) Never create a cavity
   b) Never undercut
2. Be as gentle as possible
   a) Only use small, blunt instruments
   b) Use the least possible number passages
3. Respect the superficial layer of fat
4. It is not so much what is removed that is important, but what is left behind
5. Use, anticipate, and estimate skin retraction instead of fighting against it
6. Do not undertake an "important" resection that is locally and generally dangerous
7. Indications should be restrictive
   a) Adipoaspiration is not a panacea
8. All fat resection is final
9. Results in the operating room approximate the final result
10. This technique demands "blind" surgery

Table 18.3. The Ten Commandments of the liposculptor

1. Small caliber lipodissectors (cannulae) must be used having a full blunt tip with only one blunt orifice
2. The blunt orifice must point downwards
3. The fat tissue must be infiltrated with normal saline chilled at 2°C containing adrenaline (1 mg/l) and the tissues must be well distended
4. Use a syringe for extraction
5. The technique should be the least traumatic possible. Never move lateral with the cannula
6. The dissection-extraction should be carried out fan-shaped from the skin punctures made with an awl
7. The dissection-extraction must be deep and the approach as close as possible to the adiposity; it will be accomplished in superposed layers
8. The dissection-extraction is made of true tunnels, between which are the fat tissue columns (at least two approaches). In most cases it will be criss-crossed (at least one supplementary approach)
9. The left hand dominates the operation
10. It is always necessary to do a peripheral mesh undermining, remodel the tissues and immobilize

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19 Patient Consultation and Instructions for Liposuction

Sid Mirrafati

19.1 Introduction

The surgeon should have a careful discussion with the patient as well as an appropriate physical examination prior to any decision to perform liposuction. There should be an explanation of the procedure, the limitations of the procedure and the possible complications.

19.2 State of Mind

Evaluate the patient's state of mind. When the patient comes for a consultation, it is very important to carefully examine the patient. Ask questions to evaluate their state of mind and make sure they have realistic expectations of the possible results. Find out what their reason is for having liposuction, and if they are doing it for themselves or for others, such as their spouse or boyfriend. It is important that the surgery should purely be done for themselves. Liposuction surgery does not make a depressed patient well but it will bring happiness to a well patient. Liposuction surgery is not the treatment for weight loss. Patients who are interested in losing a few pounds overnight without maintaining a proper diet and exercising are not good candidates for liposuction surgery.

19.3 Limitations of Surgery

The patient should be told about the limitations of liposuction. Liposuction surgery is not the treatment for cellulite, although it is possible with low vacuum, small cannulas, and massage-tumescent technique, to improve cellulite by over 50 %. Often questions are asked during the consultation as to how many sizes in clothing will be reduced or how many pounds would be lost after the liposuction surgery. It should be explained to the patient that there is no way that it can be predicted how many sizes an individual will reduce in clothing or how many pounds will be lost. The patient should be told that as a liposuction surgeon we are looking for a global aesthetic improvement in the shape of the body, comparing the preoperative photo to the postoperative photos. It is very important to take numerous preoperative photos from the areas going to be liposuctioned.

Often patients want many areas liposuctioned at one time. It should be explained to the patient that the maximum amount of liposuction that can be performed in an outpatient surgical facility at one time is 5 l. Patients have a faster recovery and minimal complications when a maximum of 4 l of total fluid is liposuctioned.

Another misperception is that patients think that liposuction will lift or pull their skin and the result would be a smooth and stretched skin. Liposuction does not lift or pull the skin. The waviness in the skin preoperatively will improve after liposuction but it will not completely resolve. Also, it should be explained that total symmetry cannot be achieved after liposuction.

The benefits, risks, and complications must be discussed with the patient.

19.4 Examination of Areas To Have Liposuction

Carefully examine each area that the patient desires to have liposuctioned. There are certain areas like the inner thighs or the arms that need special attention when doing liposuction. When examining the leg make sure that the patient understands that the liposuction does not reduce the muscular or big bony leg. Look for fatty deposits in the lateral thigh, the hips, and the flanks. The surgeon should create and envision a sculpted and proportionate body. Sometimes in order to have aesthetically pleasing legs, the lateral thighs and the hips need liposuction as well as fat transfer to any depressed areas or dimples in order to achieve a sculpted appearance (Figs. 19.1, 19.2). If the dimple is not severe liposuctioning, the lateral thigh alone can result in a sculpted appearance (Fig. 19.1). If the dimple is severe (Fig. 19.2) it should be explained to the patient that although there would an improvement with liposuction, there would not be a sculpted look unless fat transfer is done. It is very difficult to convince a patient that not

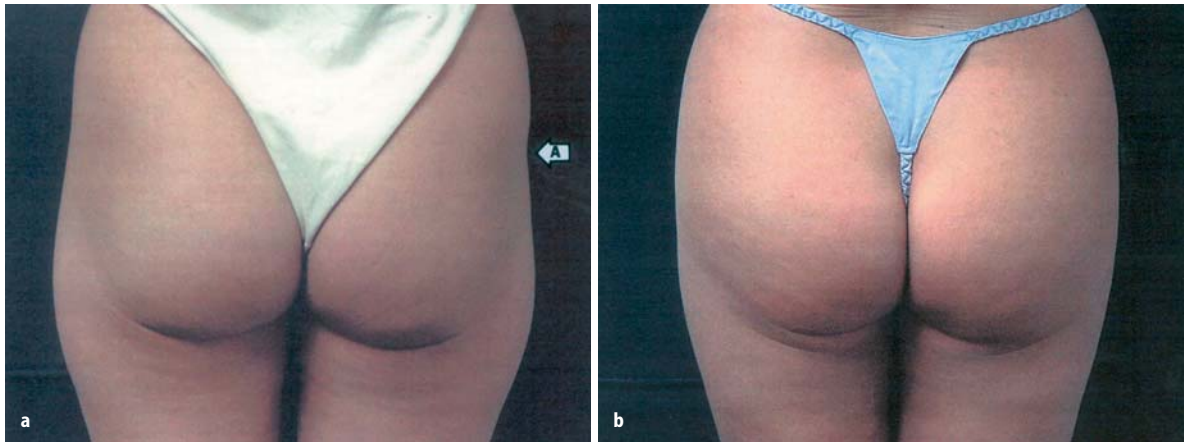

Fig. 19.1. a Mild depression, "dimple" (*arrow*), between fat excesses in lateral thighs and hips. **b** Loss of the depression after liposuction of hips and lateral thighs. Note pleasant curves from hips to thighs

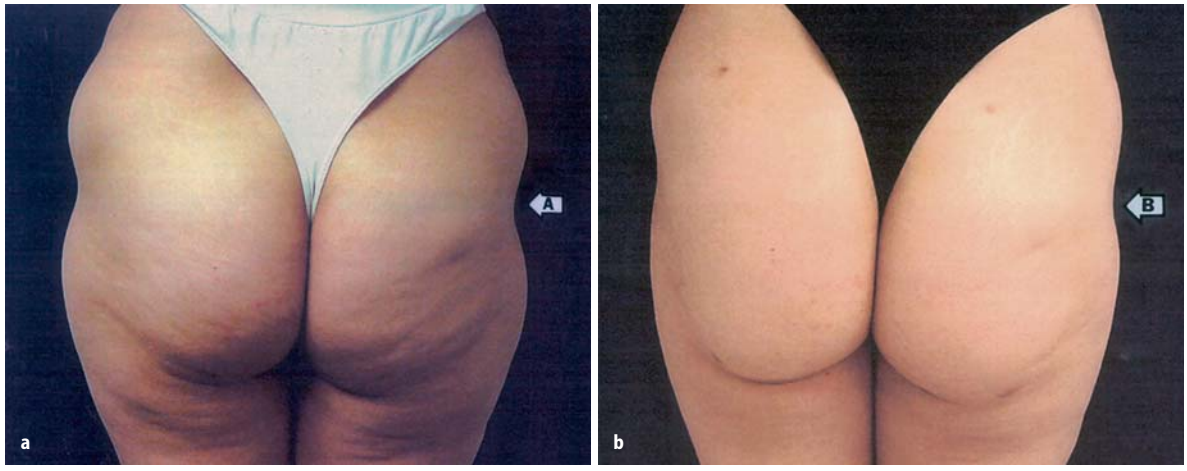

Fig. 19.2. a Severe depression, "dimple" (*arrow*), between fat excesses in lateral thighs and hips. **b** Depression (*arrow*) persists after liposuction without fat transfer

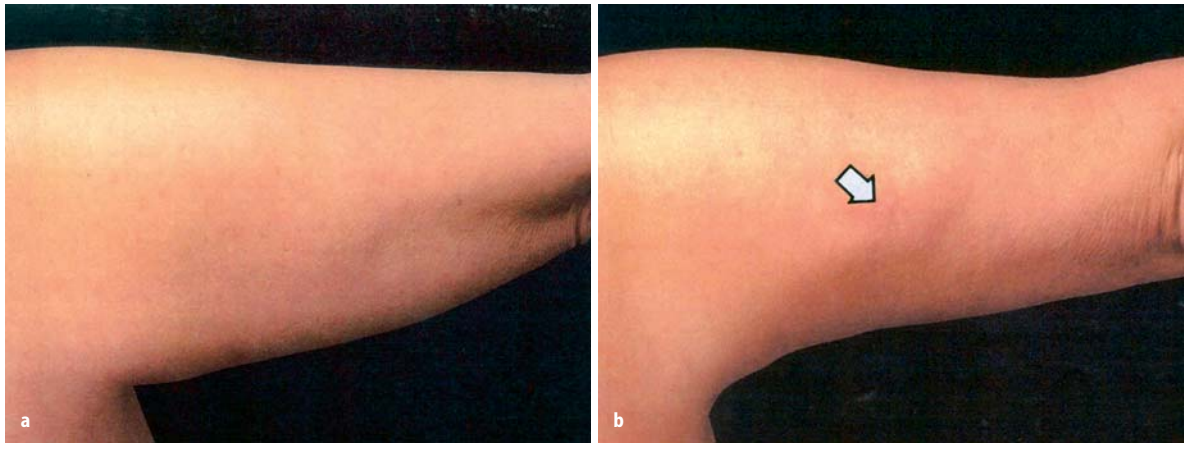

Fig. 19.3. a Posterior view of arm with excess fat and hanging skin prior to liposuction. **b** Posterior view of arm following liposuction. Note the slight natural depression (*arrow*) next to the triceps muscle

only fat should be taken out but also that fat must be transferred. It should be explained that sometimes in order to level out the mountains and the valleys, the mountain should be reduced by liposuction and the valleys elevated by fat transfer. When liposuctioning the arms it should be explained that the normal muscular arm has an indentation at the junction of the head of the triceps. In order to sculpt the arm, this depression should be explained to the patient as a normal variant and not mistaken for a dent that resulted from poor liposuction technique (Fig. 19.3).

19.5 Diet

Patients should be told that fatty areas can recur if they do not maintain a proper diet. Liposuction is not a treatment for weight loss. Proper diet should be maintained if they desire a long-lasting result. They should also be reminded that as they age their basal metabolic rate (BMR) will decrease; therefore, in order to keep a desirable weight their exercise should be increased for more caloric burning or the consumption of food (caloric intake) decreased.

19.6 Preoperative Appointment

After the initial consultation and examination of the areas that need to be liposuctioned, a preoperative appointment should be made for another day. This will allow the patient to think about some of the questions that were not discussed and have a few days to digest the topics that were discussed. During the preoperative appointment, the risks, benefits, and alternatives to the procedure should be again described. The patient is given written preoperative instructions. Patients are given prescriptions for Keflex 500 mg taken twice a day starting the day before the surgery, skipping the day of the surgery if intravenous antibiotics are utilized the day of surgery and continued for 9 days after surgery. The patient is given pain medication depending on their pain threshold and allergies. The medications normally given are either Vicodin ES or Darvocet taken once every 4 h as needed for pain. Mephyton (vitamin K) is taken once daily starting a week before surgery. A list of medications and herbal supplements (Tables 19.1, 19.2) to avoid for a week before surgery is given to the patients. Patients are told to stop taking multivitamin pills because they contain vitamin E, which is known to thin the blood. Vitamin C, 1,000 – 1,500 mg, is suggested because it promotes wound healing. Patients must stop taking any aspirin, ibuprofen, or any drugs that thin their blood coagulation starting 10 days before surgery. The complete lists of medications and herbals that should be avoided are included in the preoperative package that is given to the patient. Patients having sedation or general anesthesia are told to avoid drinking or eating starting at midnight before surgery. If the patient is having local anesthesia via tumescent infiltration, a light breakfast may be eaten on the morning of surgery in order to avoid hypoglycemia during the day. An antibacterial soap is provided for the patient to shower and wash the areas to be liposuctioned on the morning of surgery. Patients are told to wear loose fitting clothing and cover their bedcover sheets with plastic sheets or bags because drainage should be expected for the initial 24 – 36 h.

Consent documents are given to the patient to read and sign. It is important to have the informed consent read and signed at the preoperative visit and the surgical consent signed on the day of the surgery. The risks and complications sheet for the liposuction are each circled and discussed fully and the patient signs at the bottom (Table 19.3). The document that deals with the risks and complications should be read and explained to the patient and signed by the patient and the doctor (Table 19.4). The general consent as well as the liposuction consent sheets (Tables 19.5, 19.6) should be read and signed. Each statement should be read and initialed at the bottom on the presurgery visit.

The Health Questionnaire sheet (Table 19.7) should be fully completed by the patient. The authorization for and the consent to surgery sheet (Table 19.8) should be filled out and signed.

19.7 Photos

The most important part of doing cosmetic surgery is taking good pre- and postoperative photos; therefore the photo release form (Table 19.9) should always be filled out. If patients do not wish to consent having their photo shown to anyone, the appropriate line can be crossed out and “chart only” written. Be aware that if there is no preoperative photo there is nothing to compare the result with or if there are any deformities prior to surgery there is no proof to show that the deformities were not caused as the result of the liposuction. In some rare cases, where the patient refuses to have any photos taken even for only the chart, refuse to do the surgery.

Table 19.1. List given to patients of medications to avoid for a week before surgery

Aspirin and Ibuprofen Drugs
These prescriptions and nonprescription medications must be discontinued at least 2 weeks before any surgical procedure. These specific preparations have been found to seriously affect your blood by increasing the length of time it takes for the blood to coagulate and decreasing red blood cell production. If you are taking antiarthritis or anticoagulants for control of a medical disorder, you must notify our medical staff so we can determine whether these drugs will cause problems during surgery or will interfere with proper healing. This list may not be complete. If you are taking any medication you must tell us about it
Non-prescription with aspirin Alka-Seltzer antacid and pain reliever Flavored effervescent plain and extra strength Anacin analgesic coated caplets Tablets and extra strength Arthritis pain formula by Anacin Analgesic tablets and caplets Ascriptin tablets AD and extra strength BC powder and arthritis strength BC powder Bayer children's chewable aspirin and cold tablets Eight-hour Bayer time release aspirin Coma arthritis pain reliever Ecotrim tablets and maximum strength Empirin aspirin Excedrin extra strength analgesic tablets and Caplets Four-way Dia-Gesic cold tablets Genuine Bayer and maximum Bayer Measuring tablets Midol maximum strength for cramps and original formula Momentum muscular backache formula Norwish aspirin and extra strength St. Joseph aspirin for children Triaminic tablets Ursinus Inlay-Tabs Vanquish **Prescription medicines with aspirin** Easprin **Antiarthritics** Butazolidin capsules and tablets Clinoril tablets Ecotrin capsules and tablets Feldene capsules Indocin capsules, oral suspension and suppositories Indomethacin capsules Maximum Bayer aspirin Medrol tablets Motrin tablets Nalfon puvules and tablets Naprosyn Rufen tablets Tolectin tablets and DS capsules Zorpin **Ibuprofen medicines** Advil ibuprofen caplets and tablets Madipren ibuprofen caplets and tablets Midol advanced pain formula tablets Nuprin ibuprofen/analgesic tablets Trendar ibuprofen tablets **Antacids with aspirin** Alka-Seltzer effervescent pain Reliever and antacid plain and flavored Alka-Seltzer plus cold Axotat BAC tablets Fiogesic tablets Norgesic and Norgesic Forte Supac Synalogos DC capsules **Controlled analgesics with aspirin** Ascription with codeine Darvon compound/Compound 65 Emperin with codeine Fiorinal and Fiorinal with codeine Micrainin Percodan & Percodan-Demi Synalgon-DC Darvon with ASA & Darvon-N with ASA Talwin compound **Anticoagulants** Calciparine injection Cumadin Heparin lock flush solution in Tubex and heparin Sodium injection Heparin sodium injection USP sterile solution Mephytn tablets Protamine sulfate

Table 19.2. Herbs, foods, and spices to be avoided for at least 2 weeks prior to any surgery. Note that everyday foods and spices are listed in bold letters

Agrimony (*Agrimonia eupatoria,* agromonia, cocklebur): coagulant effect from vitamin K constituent
Alfalfa (*Medicago sativa,* lucerne, purple medick): anticoagulant effect from coumarin constituents and coagulant effect from vitamin K
Angelica (*Angelica archangelica,* root of the Holy Ghost): anticoagulant and antiplatelet effect from coumarin constituents
Anise (*Pimpinella anisum,* aniseed, sweet cumin): anticoagulant effect from excessive doses from coumarin constituents
Arnica (*Arnica montana,* leopard's bane, wolf's bane, mountain tobacco): anticoagulant effect from coumarin constituents
Asafoetida (*Ferula assa-foetida,* assant, fum, giant fennel, devil's dung): anticoagulant from coumarin constituents
Aspen (*Populi cortex, Populi folium*): antiplatelet effect from salicin constituent
Black cohosh (*Cimicifuga racemosa,* bugwort, black snakeroot, baneberry): antiplatelet effect from salicylate constituent
Bogbean (*Menyanthes trifoliata,* water shamrock, buckbean, marsh trefoil): bleeding risk from unknown constituent
Boldo (*Peumus boldus,* boldine): anticoagulant effect from coumarin constituents
Borage seed oil (*Borago officinalis,* starflower, burage): anticoagulant effect from gamma linolenic acid and antiplatelet effect
Bromelain (*Ananas comosus,* bromelin): anticoagulant effect from enzyme constituent
Capsicum (*Capsicum frutescens,* African pepper, cayenne, chili pepper): antiplatelet effect from capsaicinoid constituents
Celery (*Apium graveolens,* smallage, *Apii fructus*): antiplatelet effect from apiogenin (coumarin) constituent
Clove (*Syzygium aromaticum,* caryophyllus): antiplatelet effect from eugenol constituent
Danshen (*Salvia miltiorrhiza,* red sage, salvia root): anticoagulant effect from protocatechualdehyde 3,4-dihydroxyphenyl-lactic acid constituent
Dong quai (*Angelica sinensis,* danggui, Chinese angelica): anticoagulant and antiplatelet from coumarin constituents
European mistletoe (*Viscum album,* devil's fuge, drudenfuss, all-heal): coagulant effect from lectin constituent
Fenugreek (*Trigonella foenum-graecum,* bird's foot, Greek hay): anticoagulant effect from coumarin constituents
Feverfew (*Tanacetum parthenium,* bachelor's button, featherfew, midsummer daisy): antiplatelet effect from the crude extracts
Fish oils (omega-3 fatty acids): antiplatelet effect with prostacyclin synthesis, vasodilatation, reduced platelets and adhesiveness, and prolonged bleeding time
Fucus (*Fucus vesiculosis,* kelp, black tang, bladder wrack, cutweed): anticoagulant effect which can increase the risk of bleeding
Garlic (*Allium sativum,* nectar of the gods, stinking rose): inhibition of platelet aggregation and can increase risk of bleeding in excessive doses
Ginger (*Zingiber officinale*): anticoagulant effect with increased risk of bleeding
Ginkgo (*Ginkgo biloba,* maidenhair): inhibits platelet aggregation and decreases blood viscosity
Ginseng (*Panax ginseng,* Asian ginseng, Korean red, jintsam): anticoagulant and antiplatelet effects
Goldenseal (*Hydrastis canadensis,* eye balm, yellow puccoon): coagulant effect from berberine constituent
Horse chestnut (*Aesculus hippocastanum,* escine, venostat): anticoagulant effect from aesculin (coumarin) constituent
Horseradish (*Armoracia rusticana,* pepperrot, mountain radish): anticoagulant effect from coumarin constituents
Licorice (*Glycyrrhiza glabra,* sweet root): antiplatelet effect from coumarin constituent
Meadowsweet (*Filipendula ulmaria,* bridewort, dropwort): anticoagulant effect from salicylate constituents
Northern prickly ash (*Xanthoxylum americanum,* pepper wood, toothache bark): anticoagulant effect from coumarin constituents
Onion (*Allium cepa*): antiplatelet effect from unknown constituent
Papain (*Carica papaya*): bleeding risk from unknown constituent
Passionflower (*Passiflora incarnata,* apricot vine, maypop): anticoagulant effect from coumarin constituents
Pau D'Arco (*Tabebuia impetiginosa,* ipes, taheebo tea, lapacho): anticoagulant effect from lapachol constituent
Plantain (*Plantago major,* common plantain, greater plantain): coagulant effect from vitamin K constituent
Poplar (*Populus tacamahacca,* balm of Gilead): antiplatelet effect from salicin constituent
Quassia (*Quassia amara,* bitterwood): anticoagulant effect from coumarin constituents
Red clover (*Trifolium pratense,* trefoil, cow clover, beebread): anticoagulant effect from coumarin constituents
Roman chamomile (*Chamaemelum nobile,* English chamomile, whig plant, garden chamomile): anticoagulant effect from coumarin constituents
Safflower (*Carthamus tinctorium,* **saffron**, zaffer): anticoagulant effect from safflower yellow constituent
Southern prickly ash (*Zanthoxylum clava-herculis,* sea ash, yellow wood): anticoagulant effect from coumarin constituents
Stinging nettle (*Urtica dioica,* nettle): coagulant effect from vitamin K constituent
Sweet clover (*Melilotus officinalis,* hay flower, common melilot, sweet lucerne): anticoagulant effect from dicumarol constituent
Sweet vernal grass (*Anthoxanthum odoratum,* spring grass): anticoagulant effect from coumarin constituent
Tonka bean (*Dipterux odorata,* coumarouna, torquin bean): anticoagulant effect from coumarin constituent
Turmeric (*Curcuma longa,* **Indian saffron**, tumeric): antiplatelet effect from curcumin constituent
Vitamin E (alpha-tocopherol): inhibits platelet aggregation and adhesion and interferes with vitamin-K-dependent clotting factor in large doses
Wild carrot (*Daucus carota,* Queen Anne's lace, beesnest plant): anticoagulant effect from coumarin constituents
Wild lettuce (*Lactuca virosa,* **green endive**, lettuce opium): anticoagulant effect from coumarin constituents
Willow bark (*Salix alba,* white willow, silbereide): antiplatelet effects from salicylate constituents
Yarrow (*Achillea millefolium,* wound wort, thousand-leaf): coagulant effect from achilleine constituent

Table 19.3. Side effects after surgery

Usual	Liposuction
Bruising	Fluid leakage (will drain for 3 – 4 days)
Oozing (blood-tinge)	Dizziness (get up slowly)
Dizziness (get up slowly)	Swelling could be serum build-up (seroma/ hematoma). Call us
Wound infection (pain, swelling and drainage)	Hot spots (ice and hot compresses)
Hot spots (ice and hot compresses)	Contour defects – lack of symmetry, dents and waviness (a.k.a = cellulite)
Marks at incision sites (will lighten)	Skin texture changes usually disappear
Fluid build-up (call us, come in)	Numbness; normal for up to 1 year
Asymmetry (possible need for additional surgery)	Skin slough
Checks... Smokers Vegetarians slow to heal Tylenol OK No aspirin No vitamin E	**Checks...** Hernias

Table 19.4. Document dealing with the risks and complications

COSMETIC SURGERY
1101 Bryan Ave Suite #G Tustin CA 92780

Patient Name: _____ Date: _____

Operation Discussed: _____

- ❑ Methods
- ❑ Goals
- ❑ Lack of Guarantee of Results
- ❑ Possible Need for Additional Surgery/Treatment
- ❑ Complications and Risks
- ❑ Alternatives of Treatment
- ❑ Risks of Alternatives
- ❑ Risks of No Treatment
- ❑ Medication Reaction
- ❑ Scarring
- ❑ Bleeding
- ❑ Lumps and Bumps
- ❑ Asymmetry
- ❑ Numbness
- ❑ Facial Paralysis
- ❑ Infection
- ❑ Pigmentation Abnormalities
- ❑ Patient Understands and Agrees

Patient's Signature: _____

Physician's Signature: _____

Table 19.5. General consent sheet

COSMETIC SURGERY
1101 Bryan Ave Suite G Tustin CA 92780
Office (714) 544-8678 Fax (714) 544-6118

REQUEST FOR SURGICAL SERVICES AND INFORMED CONSENT

To the patient: You have the right to be informed about your condition and its treatment so you may make the decision whether or not to undergo the procedure after knowing the risks and hazards involved. This disclosure is not meant to scare or alarm you; it is simply an effort to make you better informed so you may give or withhold your consent for treatment.

I voluntarily request my physician, Dr. _____, and such associates, technical assistants and other health care providers he/she may deem necessary, to treat my condition. The procedure has been explained to me as:

_____

_____

_____

I understand that my physician can discover other conditions, which require additional or different procedures than those planned. I authorize my physician, and such associates, technical assistants, and other health care providers to perform other procedures that are advisable in their professional judgment.

Initial if you understand and agree _____

I understand that no warranty or guarantee has been made to me as to result or cure. Realistic expectations are 50–75% improvement. Some patients have great improvement and some have no appreciable improvement.

Initial if you understand and agree _____

Just as there are risks and hazards of continuing my present condition without treatment, there are also risks and hazards to the performance of the surgical, medical and/or diagnostic procedures planned for me. I realize that common to surgical, medical and/or diagnostic procedure is the potential for infection, allergic reactions, bruising, bleeding, or hematoma formation. I also realize that the following risks and hazards may occur in connection with the particular procedure: (1) worsening or unsatisfactory appearance, (2) creation of additional problems such as: (a) poor healing or skin loss, (b) nerve damage, (c) painful or unattractive scarring, keloid formation or permanent skin pigment change or (3) recurrence of the original condition.

Initial if you understand and agree _____

Dizziness may occur during the first week following surgery, particularly upon rising or lying or sitting position. If this occurs, extreme caution must be exercised while standing. Someone must be present when you shower during the early postoperative period. Do not attempt to walk if dizziness is present.

Initial if you understand and agree _____

I understand that secondary revisions or additional surgeries may be required in some cases. The cost of any of these additional surgeries is one-half the original surgeon's fee. I understand that I will also be required to pay the additional anesthesia and operation room fees.

Initial if you understand and agree _____

I understand the risk involved in surgery and I am fully aware of the dangers of anesthesia. I accept such risks and can fault neither the doctors and/or the anesthetist if an unfavorable circumstance should arise.

Initial if you understand and agree _____

I understand that the practice of medicine and surgery is not an exact science and I acknowledge that no guarantees have been made to me as to the results of the operation or procedures nor are there any guarantees against an unfavorable result.

Initial if you understand and agree _____

I have received a thorough explanation of my preoperative instructions. I understand these instructions and have received copies for reference. I understand that should I have any questions about the preoperative instructions I should not hesitate to call. I acknowledge my obligation to follow these instructions closely and to visit the clinic for follow-up care and instructions on postoperative day one, five and ten.

Initial if you understand and agree _____

I certify that I have read the above consent and fully understand it. I have been given ample opportunity for discussion and all my questions have been answered to my satisfaction. I have received no medication before signing this consent. I hereby consent to surgery. This constitutes the full disclosure and supersedes any previous verbal or written disclosures.

Initial if you understand and agree _____

NOTE: SINCE SMOKERS HAVE A HIGHER RATE OF RESPIRATORY COMPLICATIONS AND DELAYED WOUND HEALING, SMOKING IS NOT RECOMMENDED BEFORE OR AFTER SURGERY.

Patient's Pre-Surgery Signature Date and Time _____

Witness Signature _____

Table 19.6. Liposuction informed consent sheet

COSMETIC SURGERY
1101 Bryan Ave Suite G Tustin CA 92780
Office (714) 544-8678 Fax (714) 544-6118

LIPOSUCTION INFORMED CONSENT

To the patient: You have the right to be informed about your condition and its treatment so that you may make the decision whether or not to undergo the procedure after knowing the risks and hazards involved. This disclosure is not meant to scare or alarm you; it is simply an effort to make you better informed so you may give or withhold your consent for treatment.

I voluntarily request my physician, Dr. _____ and such associates, technical assistants and other health care providers he may deem necessary, to treat my condition. The procedure has been explained to me as:

_____

_____

I understand that my physician can discover other conditions, which require additional or different procedures than those planned. I authorize my physician, and such associates, technical assistants, and other health care providers to perform other procedures that are advisable in their professional judgment.

Initial if you understand and agree _____

I understand that my physician can discover other or different conditions, which require additional or different procedures than those planned. I authorize my physician, and such associates, technical assistants, and other health care providers to perform other procedures that are advisable in their professional judgment.

Initial if you understand and agree _____

I understand that no warranty or guarantee has been made to me as to result or cure. Realistic expectations are 50% to 75% improvements. Some patients have great improvement and some have no appreciable improvement.

Initial if you understand and agree _____

Just as there are risks and hazards of continuing my present condition without treatment, there are also risks and hazards to the performance of the surgical, medical and/or diagnostic procedure planned for me. I realize that common to surgical, medical and/or diagnostic procedure is the potential for infection, allergic reactions, bruising, bleeding, or hematoma formation. I also realize that the following risks and hazards may occur in connection with the particular procedure: (1) worsening or unsatisfactory appearance, (2) creation of addition problems such as: (a) poor healing or skin loss, (b) nerve damage, (c) painful or unattractive scarring, keloid formation or permanent skin pigmentation change or (3) recurrence of the original condition.

Initial if you understand and agree _____

I understand that secondary revisions or additional surgeries may be required in some cases. The cost of any of these additional surgeries is one-half the original surgeon's fee. I understand that I will also be required to pay the additional anesthesia and operating room fees.

Initial if you understand and agree _____

I understand the risk involved in surgery and I am fully aware of the dangers of anesthesia. I accept such risks and can fault neither the doctor and/or the anesthetist if an unfortunate circumstance should arise.

Initial if you understand and agree _____

I am aware that the practice of medicine and surgery is not an exact science and acknowledge that no guarantees have been made to me as to the result of the operation or procedures nor are there any guarantees against an unfavorable result.

Initial if you understand and agree _____

I hereby consent to surgical operation to remove the excess fat from under the skin on my body. The procedure has been explained to me by the medical staff and I completely understand its nature and consequences.

Initial if you understand and agree _____

I understand that every surgical procedure involves certain risks and possibilities of complication such as bleeding, infection, poor healing, blood clots in the veins and lungs, hemorrhage and allergic reactions. I understand that these and other complications may follow even when the surgeon uses the utmost care, judgment, and skill. These risks have been explained to me, and I accept them. The following points have been explained to me in detail:

LIPOSUCTION INFORMED CONSENT

1. Liposuction is a body contouring operation, and while every effort is taken to remove fat smoothly in its distribution, postoperation irregularities and asymmetry do arise. While such things can often be corrected, no guarantee has been made to me with respect to eventual final results.

   Initial if you understand and agree _____

2. Areas of "cottage cheese" texture, i.e., "cellulite" will be changed little by in the liposuction procedure.

   Initial if you understand and agree _____

3. Numbness or increased sensitivity of the skin over treated areas may persist for months. It is possible that localized areas of numbness or increased sensitivity may be permanent.

   Initial if you understand and agree _____

Table 19.6. (Cont.)

4. Dizziness may occur during the first week following liposuction surgery, particularly upon rising from a lying or sitting position. If this occurs, extreme caution must be exercised while standing. Someone must be present when you shower during the early postoperative period. Do not attempt to walk if dizziness is present.
Initial if you understand and agree _____
5. I understand that small incisions do have to be made, and these incisions will result in scars. Such scars could hypertrophy or widen in time and, although efforts will be made to conceal them, they may be obvious in certain situations and circumstances.
Initial if you understand and agree _____
6. I understand that further dietary abuse and lack of proper motivation to exercise may result in eventual return of the fat.
Initial if you understand and agree _____
7. Swelling occurs in all patients treated, and I understand that swelling often persists for 2 – 3 months. I agree to be patient and also to cooperate in every respect, especially in postoperative visits to insure that the swelling goes away.
Initial if you understand and agree _____

I consent to being photographed before, during, and after the treatment and these photographs shall be the property of Dr. _____ and may be used as they deem proper for scientific and educational purposes.
Initial if you understand and agree _____

I have received a thorough explanation of my preoperative and postoperative instructions. I understand these instructions and have received copies for reference. I understand that if I have any questions about the preoperative or postoperative instructions I should not hesitate to call. I acknowledge my obligation to follow these instructions closely and to visit the clinic for follow-up care instructions on postoperative day one, five and ten.
Initial if you understand and agree _____

I certify that I have read the above consent and fully understand it. I have been given ample opportunity for discussion and all my questions have been answered to my satisfaction. I have received no medication before signing this consent. I hereby consent to surgery. This constitutes the full disclosure and supersedes any previous verbal or written disclosures.

NOTE: SINCE SMOKERS HAVE A HIGHER RATE OF RESPIRATORY COMPLICATIONS AND DELAYED WOUND HEALING, SMOKING IS NOT RECOMMENDED BEFORE OR AFTER SURGERY.

Patient's Pre-Surgery Signature Date & Time _____

Witness Signature _____

Patient's Day of Surgery Signature Date & Time _____

Witness Signature _____

Table 19.7. Patient's health questionnaire

PATIENT'S HEALTH QUESTIONNAIRE

Patient Name: _____ **Date:** _____

Please answer all the questions and fill in the blanks when indicated. All answers to the questions will be for chart use office records only and will be considered confidential.

1. Have you had any food or drink today? ❑ Y ❑ N
2. Are you in good health? ❑ Y ❑ N
3. My last physical examination was _____
4. Are you under the care of a physician? ❑ Y ❑ N

   If so, what is the condition being treated? _____
5. The name and address of my physician is:

   _____
6. Have you had any serious illness or operation? ❑ Y ❑ N
7. Have you been hospitalized or had a serious illness within the past five (5) years? ❑ Y ❑ N
8. Do you drink alcoholic beveragesNEVER SOCIALLY SOMETIMESALWAYS
9. Do you have, or have you had, any of the following diseases or problems?
   - Rheumatic fever or rheumatic heart disease ❑ Y ❑ N
   - Congenital heart lesions ❑ Y ❑ N
   - Cardiovascular disease (heart trouble, heart attack, coronary insufficiency, coronary occlusion, high blood pressure, arteriosclerosis, stroke) ❑ Y ❑ N
   - Pain in your chest upon exertion? ❑ Y ❑ N
   - Are you short of breath after mild exercise? ❑ Y ❑ N
   - Do your ankles swell? ❑ Y ❑ N
   - Do you get short of breath when you lie down or do you *require* extra pillows for sleep? ❑ Y ❑ N
   - Allergies ❑ Y ❑ N
   - Asthma or hay fever ❑ Y ❑ N
   - Hives or skin rash ❑ Y ❑ N
   - Fainting spells or seizures ❑ Y ❑ N
   - Diabetes ❑ Y ❑ N
   - Do you urinate more than 6 (six) times per day? ❑ Y ❑ N
   - Are you thirsty much of the day? ❑ Y ❑ N
   - Does your mouth frequently become dry during the day? ❑ Y ❑ N
   - Hepatitis ❑ Y ❑ N
   - Arthritis ❑ Y ❑ N
   - Inflammatory rheumatism (painful swollen joints) ❑ Y ❑ N
   - Stomach ulcers ❑ Y ❑ N
   - Kidney trouble ❑ Y ❑ N
   - Tuberculosis ❑ Y ❑ N
   - Do you have a persistent cough or cough up blood at any time? ❑ Y ❑ N
   - Low blood pressure ❑ Y ❑ N
   - Venereal disease ❑ Y ❑ N
   - Other _____
10. Have you had abnormal bleeding associated with previous extractions, surgery or trauma? ❑ Y ❑ N
    - Do you bruise easily? ❑ Y ❑ N
    - Have you ever required a blood transfusion for a medical condition? ❑ Y ❑ N
    - If so please explain the circumstances _____

    _____
11. Do you have any blood disorders such as anemia, etc? ❑ Y ❑ N
12. Have you had surgery or X-ray treatment for tumors, growth or other condition for your mouth or lips? ❑ Y ❑ N
13. Are you taking any drug or medication, prescription or non-prescription? ❑ Y ❑ N
    - If so, please list _____
14. Are you taking any of the following?
    A. Antibiotics or sulfa drugs ❑ Y ❑ N
    B. Anticoagulants (blood thinners) ❑ Y ❑ N
    C. Medicine for high blood pressure ❑ Y ❑ N
    D. Cortisone (steroids) ❑ Y ❑ N
    E. Tranquilizers ❑ Y ❑ N
    F. Aspirin ❑ Y ❑ N
    G. Insulin, tolbutamide (Orinase) or similar drugs ❑ Y ❑ N
    H. Digitalis, drugs for heart trouble ❑ Y ❑ N
    I. Nitroglycerin ❑ Y ❑ N
    J. Other _____

Table 19.7. (Cont.)

15. Are you allergic or have you reacted adversely in any way to the following?
    - A. Local anesthetics ..... ❑ Y ❑ N
    - B. Penicillin or other antibiotics ..... ❑ Y ❑ N
    - C. Sulfa drugs ..... ❑ Y ❑ N
    - D. Barbiturates, sedatives or sleeping pills ..... ❑ Y ❑ N
    - E. Aspirin ..... ❑ Y ❑ N
    - F. Iodine ..... ❑ Y ❑ N
    - G. Other _____
16. Do you have any disease, condition or problem NOT listed that you think the DR and office should be aware of or know about? ..... ❑ Y ❑ N
    - If so, please explain: _____

    _____
17. Are you pregnant? ..... ❑ Y ❑ N

I, MYSELF, HAVE FILLED OUT THIS HEALTH QUESTIONNAIRE COMPLETELY AND I HAVE NOTIFIED THE OFFICE OF ALL MY MEDICAL PROBLEMS.

Patient's signature _____ Date _____

I HAVE BEEN INFORMED OF **ALL** RISKS INVOLVED WITH MY SURGERY AND ANESTHESIA. I WILL NOT DRINK OR EAT ANYTHING DURING THE 8 HOURS BEFORE MY PROCEDURE. I WILL BRING SOMEONE TO DRIVE ME HOME AFTER THE SURGERY.

Patient's signature _____ Date _____

Table 19.8. Authorization for and the consent to surgery sheet

AUTHORIZATION FOR AND CONSENT TO SURGERY OR SPECIAL DIAGNOSTIC OR THERAPEUTIC PROCEDURES

To (name of patient) _____

Your admitting physician is _____ M.D.

Your surgeon is _____ M.D.

1. Mira Aesthetics maintains personnel and facilities to assist your physicians and surgeons in their performance of various surgical operations, and other special diagnostic and therapeutic procedures all may involve calculated risks or complications, injury or even death, from both known and unknown causes and no warranty or guarantee has been made as to the result or cure. Except in a case of emergency or exceptional circumstances, these operations and procedures are therefore not performed on patients unless or until the patient has had an opportunity to discuss them with his/her physician. Each patient has the right to consent to or refuse any proposed operation or special procedure (based upon the description or explanation received).
2. Your physician and surgeons have determined that the operation or special procedures listed below may be beneficial in the diagnosis or treatment of your condition. Upon your authorization and consent, specific operations and/or special procedures will be performed for you by your physician and/or surgeon and/or by a physician/surgeon selected by them. The persons in attendance for the purpose of administering anesthesia or performing other specialized professional services, such as radiology or pathology, are not the agents, servants or employees of Mira Aesthetic Medical Center or your physician/surgeon, but are independent contractors performing specialized services on your behalf and, as such, are your agents, servants or employees. Any tissue or member served in an operation will be disposed of in the discretion of the pathologist, except:

   _____

   _____
3. Your signature opposite the operation or special procedures listed below constitutes your acknowledgement of: (1) that you have read and agreed to the foregoing; (2) that the operation or special procedures have been adequately explained to you by your physician or surgeon and that you have all the information that you desire; (3) that you authorize and consent to the performance of the operation or special procedures.

OPERATION OR SPECIAL PROCEDURE: _____

_____

Patient's signature _____ Date _____ Time _____

Witness _____ Date _____

IF THE PATIENT IS A MINOR OR UNABLE TO SIGN, COMPLETE THE FOLLOWING:
PATIENT IS A MINOR, OR IS UNABLE TO SIGN THE ABOVE BECAUSE:

Father _____ Guardian _____

Mother _____ OTHER _____

Date _____ Time _____ Date _____ Time _____

Table 19.9. Photo release form

COSMETIC SURGERY
1101 Bryan Ave Suite G Tustin CA 92780

PHOTO RELEASE FORM

Date: _____

For good and valuable consideration receipt of which is hereby acknowledged, I, _____ and (parents or legal guardian if the patient is under legal age of consent) _____, consent to the use of photographs film/videotape of me taken by Dr. _____ for purposes of advertising and/or trade in any promotional programs in any media. It is understood that Dr. _____ shall have sole discretion and final authority as to how said photographs are used or whether or not they are used at all, with the exception noted at the bottom of this form. We hereby discharge and release Dr. _____ and their officers, directors, employees, agents, publishers and printers from any claim, demand, cause of action or proceedings of whatever nature arising out of the publication and distribution of the said photographs in accordance with the terms of this release.

Signed: _____ Date: _____

Address: _____

_____

Signed: _____ Date: _____
(Parent or Guardian)

Address: _____

_____

Witness: _____ Date: _____

Exceptions: _____

Table 19.10. History and physical examination

HISTORY AND PHYSICAL EXAMINATION

Patient's name: _____ Age _____ Sex _____

Chief complaint: _____

History of present illness: _____

Past medical gistory (if yes, explain below):

Heart disease	❑ Y ❑ N	Kidney disease	❑ Y ❑ N	Hypertension	❑ Y ❑ N	Cerebrovascular	❑ Y ❑ N
Bleeding tendency	❑ Y ❑ N	Neurological disease	❑ Y ❑ N	Pulmonary disease	❑ Y ❑ N	Diabetes	❑ Y ❑ N
Liver disease	❑ Y ❑ N	Smoking	❑ Y ❑ N				

Explanation: _____

Allergies: _____ Medications: _____

Past surgical history: _____ None: _____

Physical examination: B/P: _____ Pulse: _____ Resp.: _____ Weight: _____ Height: _____

Neck: _____

Chest: _____

Heart: _____

Lungs: _____

Abdomen: _____

Neurological/extremities: _____

Physical findings: _____

Impression: _____

History and physical dictated: ❑ Y ❑ N

Proposed operation: _____

Signature: _____ Date: _____ Time: _____

19.8 Physical Examination

A full physical examination (Table 19.10) is performed and blood drawn for CBC, CHEM 22, PT, PTT, HIV, and in females of child-bearing age, a pregnancy test. Make sure that the HIV consent form (Table 19.11) is filled out. The acknowledgement of receiving surgery instructions and the transportation form (Table 19.12) are also filled out. A progress note for the patient to read, write, and sign that everything was explained to the patient is included in the medical record. The statement used during the preoperative appointment placed in the chart is:
"Patient here for the preoperative instructions for:

_____
(Surgery)

The risks, benefits, and alternatives to the surgery were explained. The patient has read all of the consents, and understands and agrees with all the risks, benefits, and the complications. The preoperative instructions were explained and given to the patient. The patient was told to stop smoking and taking birth control pills or hormonal therapy seven days before and after the surgery. Avoidance of the above instructions can substantially increase the chance of skin necrosis, pulmonary embolism (which is a life-threatening complication), and delays healing. This statement was read to the patient by and the patient understands and agrees."

The patient must sign and date the document along with the witness who read the statement to the patient and the patient must write in his own handwriting the following statement:

> "I have read, understand, and agree with the above statement".

The patient is also given a copy of the Patient Rights sheet (Table 19.13). In order to remember to do all these steps, a Surgical Checklist (Table 19.14) is completed and signed. After signing all of the statements, the patient is given the postoperative care sheet to take home and to review.

Table 19.11. HIV consent form

COSMETIC SURGERY
1101 Bryan Ave Suite G Tustin CA 92780
Office (714) 544-8678 Fax (714) 544-6118

HIV CONSENT FORM

Date: _____

I, _____, consent to have my blood sent to _____ Medical Laboratory for testing (HIV Screen) for AIDS. I understand that the results of this test are confidential.

Signed: _____

Witness: _____

Table 19.12. Acknowledgement of receiving surgery instructions and transportation form

COSMETIC SURGERY
1101 Bryan Ave Suite G Tustin CA 92780

ACKNOWLEDGEMENT OF RECEIVING SURGERY INSTRUCTIONS

On _____, I, _____, received the packet of Surgery Instructions. I have received a thorough explanation of my preoperative and postoperative directions. I understand these instructions and have received copies for reference. I understand that should I have any questions about these preoperative or postoperative instructions, I should not hesitate to call.

Signature _____ Date _____

TRANSPORTATION RELEASE FOR A PRIVATE OUTPATIENT

I will be receiving anesthetic and recovery room care as an outpatient. During and following my elective surgery I shall be transported and accompanied by:

Name of Person _____ Phone _____ Relation to Patient _____

This person will be present at the office awaiting my discharge from the office. I understand that I should not drive or consume any alcoholic beverages for seventy-two (72) hours following this surgical procedure.

Following my surgery, I can be reached at this telephone # _____ for the next fourteen (14) days.

I understand that I am entitled to three postoperative visits at no charge and any repeat procedures will be charged at one-half of the original fee and that any hospitalization that may be required after surgery will be at my expense.

Signature: _____ Date: _____

Table 19.13. Patient rights

1. Treatment without discrimination as to sex, religion, disability, or economic background.
2. Treatment with respect, consideration, and dignity.
3. Provision for appropriate privacy.
4. Patient disclosures and records are treated with confidentiality, and except when required by law, patients are given the opportunity to approve or refuse their release.
5. Patients are provided with all known complete information concerning their diagnosis, evaluation, treatment, and prognosis except when medically inadvisable. Then such information will be provided to a person designated by the patient or to a legally authorized person.
6. Patients are given the opportunity to participate in decisions involving their health care, except when such participation is contraindicated for medical reasons.
7. Provision of information on fees for service and payment policies.
8. Marketing or advertising regarding the competence and capabilities of the physician(s) is not misleading.
9. Rights to refuse participation in experimental research.
10. Right to change primary or specialty physician(s) at any time.
11. Right to express grievances and suggestions to physician or organization.
12. Provision for after hours and emergency care.
13. Provision with appropriate information regarding the absence of malpractice insurance coverage.
14. Notice of rights.

19.9 Surgery Day and Postoperative Care

19.9.1 Day of Surgery

The patient should sign a Consent For Surgery on the day of surgery, the day of surgery progress note, and the anesthesia consent. All clothing, jewelry, contact lens, and any dentures are removed. Preoperative pictures are taken. The area of liposuction is properly marked with a marking pen. It is important to point out to the patient any depressions or waviness in the skin so that the patient is aware of any asymmetry before surgery. Most patients do not look at their body closely before surgery but afterwards they will examine each part of their body very closely and this is why it is important to point out any deformities before surgery. Every surgery patient is called the night of surgery to make sure there are no problems. The patient is also reminded that the drainage will stop in 24–36 h.

Table 19.14. Surgical checklist

Patient Name: _____

SURGICAL CHECKLIST

Scheduling Surgery	Date	Signature
• Write on Surgical Board		
• Write in Surgical Book		
• Block out Doctor		
• Call Anesthesia		
• Order Supplies		
Pre-Op		
• Progress Notes		
• Consents		
• Photo		
• HIV		
• Arbitration		
• Lab Work		
• Risks & Benefits		
• EKG		
• Prescription		
• Surgical Scrub		
• Transportation		
• Telephone to be Reached @		
• Witness & Doctor's Signatures		
• Payment		
• Deposit: _____ Balance: _____		
Day of Surgery		
• Anesthesia Consents		
• Jewelry and/or Contacts		
• Progress Notes		
• Consents		
• Balance Paid Off		
• Pictures		
• Type in Procedure		
• Postoperative Call Sheet		
• Next Day Appointment		
Dr.'s Cell Number and/or Pager #		

19.9.2 Day after Surgery

All patients are seen on the first postoperative day. The area of liposuction is examined for seroma, infection, skin ulceration, hematoma, and unusual swelling. The padding is changed and the garment is placed making sure that there is no kink or pleating in the garment or the padding. The patient is advised that while at home he is to lie flat, sit up straight, and stand up straight. They are also told to walk a mile a day if they can tolerate it. Showers can be started on the second postoperative day but the padding and garment replaced after each shower. Baths, swimming in the pool, using the Jacuzzi, or any kind of submerging the body under the water must be avoided because the liposuction incisions are left open. On the third postoperative day the padding is removed but the garment must be worn for 4–6 weeks. Patients are seen in the office 5 days after surgery and 10 days after surgery. On the 10th day, the patient is started on abdominal exercises and/or leg exercises. The next office visits are at 6 weeks and 6 months after surgery.

19.10 Responsibilities

During the initial consultation, surgery, and postoperative checkups, the physician must always be truthful, honest, and take responsibility for any good results and bad results or complications that are surgical faults. Thoroughly explain to the patient the cause of complications, the proposed treatment of the complication, and the length of time expected for the problem to resolve.

Vibrotumescent Liposuction of the Abdominal Wall

20

Sid Mirrafati

20.1 Patient Consultation

Liposuction is one of the most commonly performed procedures, but the limitations and advantages of the procedure must be explained to the patient. Alternative procedures should be discussed, which usually include abdominoplasty. This will help to guide the patient in making an informed decision when choosing liposuction of the abdomen versus abdominoplasty. There are many different ways and techniques of performing liposuction. The vibrotumescent liposuction technique has many advantages.

It is explained to the patient that liposuction has a rapid recovery time and the patient can usually return back to a normal daily routine after only a few days and there is much less morbidity and mortality associated with liposuction in contrast to abdominoplasty. A much more sculpted appearance can be obtained with liposuction than with a conventional abdominoplasty since when an abdominoplasty is performed, many surgeons prefer not to liposuction the flanks and the sides of the abdomen. Liposuction of the lower abdomen and the upper abdomen allows sculpturing of the lateral areas to a degree that has a properly esthetic appearance in combination with the patient's hips and lateral thighs.

When performing liposuction, there is always the question of skin retraction. With the vibrotumescent technique, good skin retraction can be achieved depending on the type skin and the age of the patient (Fig. 20.1). Even stretch marks of the skin can be improved (Fig. 20.2). The vibrotumescent liposuction also has minimum bruising and minimal blood loss during and after surgery (Figs. 20.1, 20.2). Minimal blood loss during surgery and minimal bruising after surgery is also partly dependent upon preoperative care instructions. The vibrotumescent technique can achieve better results than with conventional tumescent liposuction even with the addition of internal ultrasound and/or external ultrasonic assisted liposuction. There are fewer complications, skin necrosis, and skin burn. One other advantage is improvement of cellulite. Although there may be claims that liposuction can treat the cellulite problem, most patients having vibroliposuction have noticed improvement in their cellulite, decreasing by over 50 %. The vibrotumescent technique appears to break up the trabecular attachments of the skin to the underlying structures, which is the primary cause of the cellulite formation. Another advantage of the vibrotumescent technique is the even distribution of the tumescent fluid, which is infiltrated into the subcutaneous fat of the areas undergoing liposuction. This will al-

Fig. 20.1. a Preoperative 43-year-old female with excess fat of the abdomen and loose lower abdominal skin. **b** One week postoperatively following vibroliposuction of abdomen with excellent skin retraction and no bruising

Fig. 20.2. a Preoperative 28-year-old male with excess fat of abdomen and hips associated with marked striae of lower abdomen. **b** One week postoperatively following vibroliposuction. Note marked improvement of striae of lower abdomen and no bruising

Fig. 20.3. Vibration (percussion massaging) of the abdominal wall after infiltration of tumescent fluid results in emulsification of the fat

low the surgeon to do proportionate liposculpting of the body.

Vibration of the area after infiltration of the tumescent fluid causes emulsification of the fat cells (Fig. 20.3). It is obvious that the fat cells are more disrupted and injured. There is also more oil present in the aspirate. The pathology report from liposuction with vibration shows 80% more disrupted and disfigured fat cells.

20.2 Surgical Technique

To do liposuction surgery, the procedure starts from the preoperative room taking the appropriate photos, and carefully marking the areas of liposuction to be done. The most elevated areas are marked at the center as well as the depressed areas, but using a different color marking pen. This is to avoid liposuctioning the wrong areas.

At surgery the patient is thoroughly prepped with betadine solution. There are some surgeons who believe that prepping the patient for liposuction or even using sterile gloves to perform liposuction is not necessary due to the bactericidal effect of the lidocaine present in the tumescent fluid. It is not true that tumescent fluid will prevent infection. Make sure to prep the patient with betadine rather than take the chance of having a complication or infection. It is far better to take a few extra minutes to prep the patient for a sterile surgery. Tumescent fluid is injected slowly and dispersed evenly into the subcutaneous fatty layer. The tumescent fluid consists of 1,000 cc lactated Ringer's with 2 mg epinephrine and 500 mg of lidocaine. The usual tumescent fluid injected to aspiration is 1:1. The percussion massaging machine (Model: PA-1, HoMedic Inc., Commerce Township, MI) is used to massage each area for 5 min (Fig. 20.4) following tumescent infiltration.

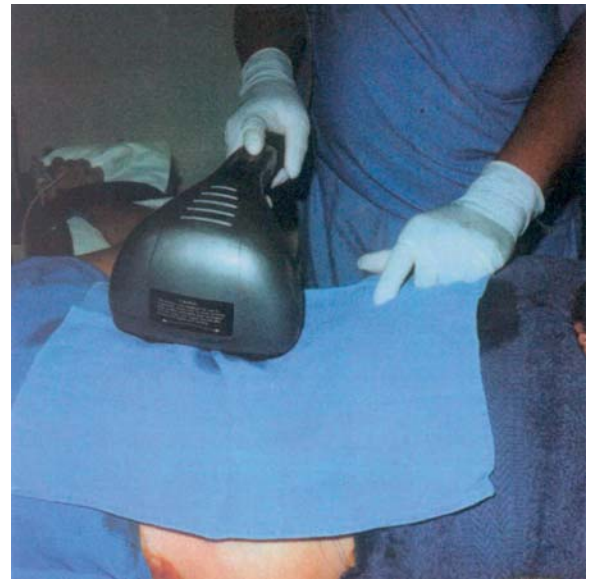

Fig. 20.4. Massaging the abdominal areas with the vibration machine over a sterile towel

When the massage is completed the areas are back to their original shape as it was before tumescent infiltration.

Liposuction is performed using 2.5 – 4.0 mm cannulas under low vacuum (200 – 300 mm). Larger sized cannulas cause more trauma and increase the chance of indentations and depressions that can result in waviness and cannula tract marks.

Full strokes should be performed evenly in the same layer working from the deep plane to the superficial plane. Even pressure is applied to the skin using the palm of the non-dominant hand (Fig. 20.5). The non-dominant hand should be used as a guide directing the liposuction cannula to stay in the same plane and making sure not to penetrate too deeply and injure vital organs. In the case of liposuction of the upper abdomen it is critical to use the non-dominant hand to push down on the ribs as the cannula passes in the fatty layer above the ribs (Fig. 20.6). Each tunnel is liposuctioned three times before starting a new tunnel. Never squeeze the tissue with the hand while performing liposuction (Fig. 20.7) unless you are an experienced surgeon and have done over 1,000 liposuction areas. Squeezing the tissue in your hand while doing liposuction can easily change your plane and cause depressions and waviness. If liposuction of the abdomen is done on a heavy patient, a 4.0-mm cannula is used in the deep plane and a blunt 3.0-mm cannula for the superficial plane. About 1 cm of subcutaneous fat is left. With the vibrotumescent technique the liposuctioned fat appears emulsified and oily. At the completion of the liposuction, the dominant hand is used to pinch small areas all over the abdomen checking for asymmetry and any fatty lumps that need to be corrected (Fig. 20.8).

Foam padding is applied with an abdominal binder, making sure there is even compression to the abdomen.

Fig. 20.5. Even pressure applied to abdominal wall with non-dominant hand to palpate the cannula tip

Fig. 20.6. Pressure on the lower chest wall with the non-dominant hand allows the cannula to pass easily over the ribs

Fig. 20.7. Do not compress the tissue with the hand while performing liposuction. This allows uneven suctioning of the fat

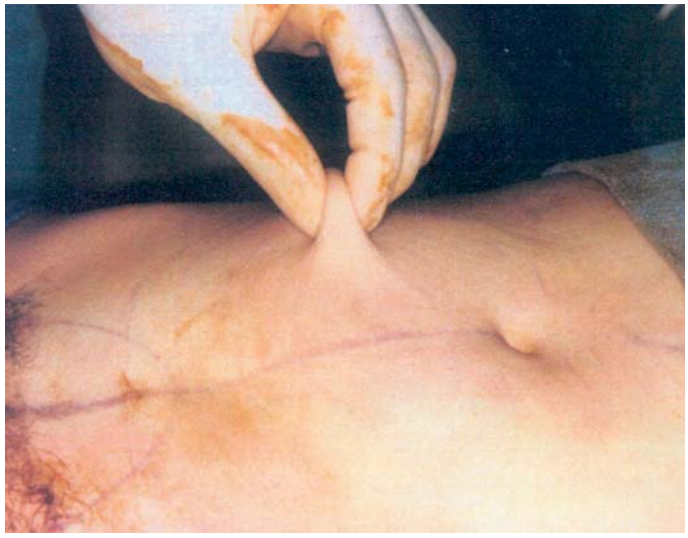

Fig. 20.8. Pinching small areas of the skin and fat following liposuction allows recognition of asymmetry and fatty lumps

The liposuction incision sites are left open with 4 × 4 s applied. This will allow for free drainage of the fluid that is infiltrated into the area. The patient should be forewarned about the drainage so that bed sheets and furniture can be protected. Free drainage decreases the chance of seroma formation and infection and allows a faster recovery. It is important to make sure there is no kink or folding in the foam and the abdominal binder.

20.3 Postoperative

Postoperatively the patient is told to either lie down flat, sit up straight, or stand up to avoid folding the garment. If the garment is folded, this will result in a fold in the skin that can result in a seroma or induration of the area, which can be difficult to treat (Fig. 20.9). This defect with subcutaneous fibrosis requires the use of ultrasound treatments (3 mHz for 15 min) to the area twice weekly for 16 sessions. Medrol DosPak should be used at the start of therapy and medication with a nonsteroidal anti-inflammatory drug (NSAID) continued until the fibrosis has subsided.

The patient is seen on the first postoperative day to correct any kinking in the garment and padding and to guide the patient to use the correct posture. All the dressings and the foam are changed. The patient is advised to walk as often as possible and told to make sure there is no folding in the binder.

On the third postoperative day the patient is again seen and the foam removed. The patient is allowed to take a shower but following the showers must immediately reapply the abdominal binder. Baths are not allowed because all the liposuction incision sites are still not properly healed.

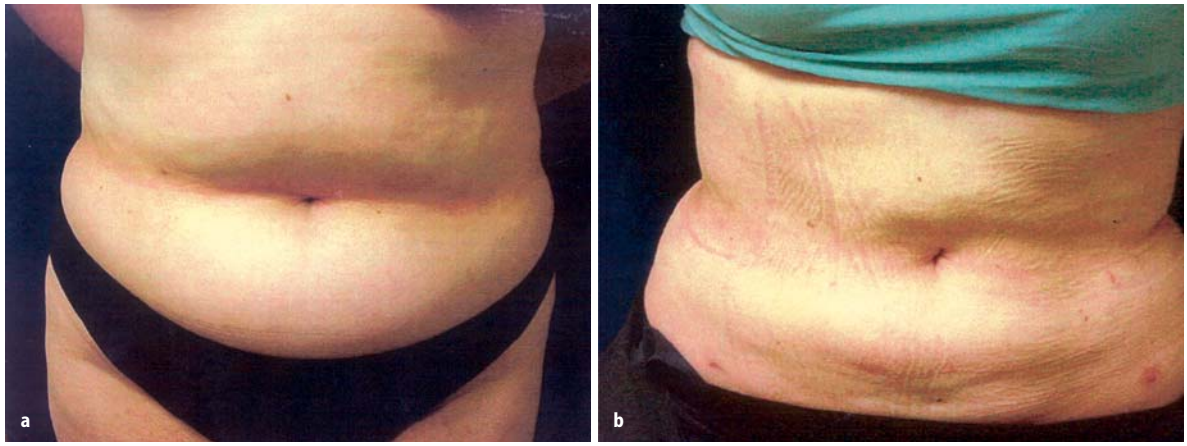

Fig. 20.9. a Preoperative patient with lipodystrophy of abdominal wall. **b** Postoperatively the patient developed an indentation and subcutaneous fibrosis in the lower abdomen from a fold in the garment

On the 10th postoperative day abdominal exercise and sit-ups are begun. The number of exercises is slowly and gradually increased every week. The abdominal binder is used continuously for the next 4–6 weeks depending on the patient age, the skin texture, and the degree of loose skin. The patient is seen again at 4–6 weeks.

20.4 Discussion

The vibrotumescent technique emulsifies the fat, allowing the fat to be removed more easily. There is less bleeding and postoperative bruising when combined with low vacuum and proper foam padding with a garment postoperatively.

21 Syringe Liposculpture of the Abdomen

Luiz S. Toledo

21.1 Introduction

I started using syringe liposculpture [1] to treat the whole body in 1988 [2]. With the advent of superficial liposculpture in 1989 [3], some areas of the abdomen, which needed skin retraction, could now be treated with liposuction instead of resection. The use of this superficial technique increased the indications for liposuction of the abdomen and reduced the number of patients for traditional abdominoplasty [4]. Borderline patients are advised that, if good enough skin retraction is not obtained through suction alone, some skin resection in a second procedure would be indicated. Until recently I would avoid the combination of liposuction and dermolipectomy in the same procedure, due to the high risk of possibly developing a seroma and the smaller, but far more serious chance of skin necrosis [5]. Now, applying a new technique, liposuction can be combined with skin resection in the same procedure. When indicated, the classic abdominoplasty may be performed.

21.2 Indications and Techniques

Most of the problems related to the abdomen occur due to the lack of criteria in classifying the abdominal wall disorder and thus the problem of choosing the appropriate surgical technique. Patient dissatisfaction can be minimized preoperatively by explaining the possibilities and limitations of each method.

Today only 20 % of my patients who are looking for improvement in the abdominal area have an indication for abdominoplasty. The other 80 % are corrected with liposculpture alone. Before 1988 this number was 50 %. In the year 2000 I started using the Avelar technique [6] allowing the performance of abdominal skin resection with simultaneous liposuction, without increasing the risk of seromas and tissue necrosis.

Depending on each case, one of three procedures may be used to treat the abdomen.

1. Syringe liposculpture
2. Syringe liposculpture + skin resection (Avelar)
3. Classic abdominoplasty (Callia)

Syringe liposculpture alone is used in 80 % of patients. The remaining 20 % are treated with either the Avelar technique, combining syringe liposculpture with skin resection, or the Callia technique [7] of classic abdominoplasty.

Syringe liposculpture is indicated for young patients with good skin tone. In most cases deep liposculpture alone will correct most adiposities, producing an even retraction of the abdominal skin (Figs. 21.1, 21.2).

If there is some skin flaccidity, superficial liposculpture is used to cause skin retraction. Superficial liposculpture should be used with extreme care to avoid unnecessary irregularities, skin dyschromia, or even necrosis and *only* in the areas where the retraction is needed.

The abdominal area and the flanks should be treated as a unit, first aspirating the flanks with the patient in the lateral position and then the abdomen hyperextended in the supine position. The hyperextended position is of great importance to avoid perforation of the wall and viscera. Wetting the skin and changing the position of the lights helps with spotting any irregularities or depressions. If present they should be treated immediately, aspirating more fat from the high points, or reinjecting some of the saved fat.

After the infiltration of the anesthesia, it takes at least 10 min for the area to become anesthesized and the tumescence to start working.

21.2.1 Incisions

As many incisions as necessary are used to obtain a good result. In some cases one incision in the pubic area will be enough to liposuction the whole abdomen. When the epigastrium has to be treated, an umbilical incision is utilized and possibly one in each submammary fold. Incisions in the iliac crest are sometimes necessary to treat the waist. The flanks are treated through a trochanteric incision.

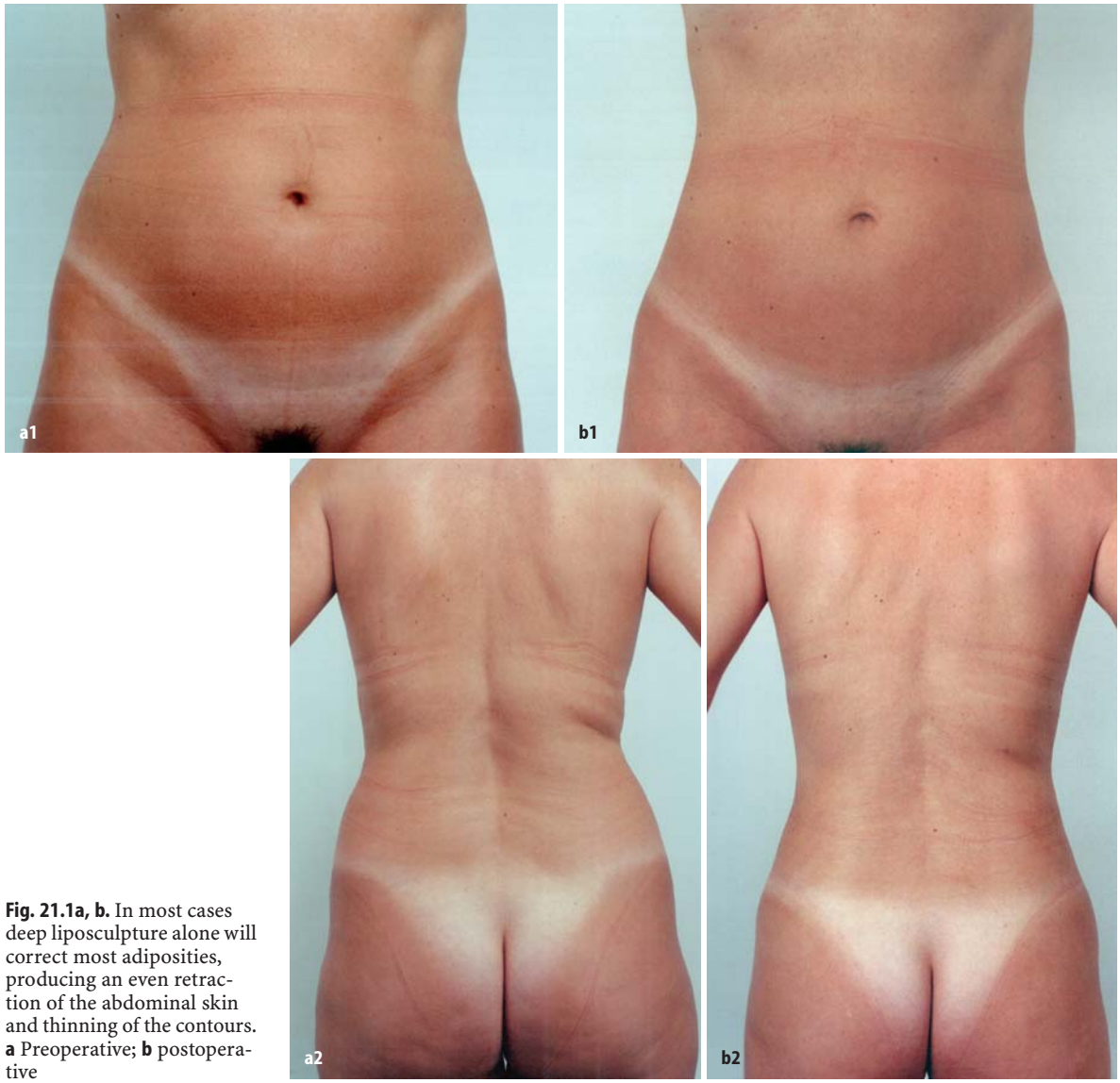

Fig. 21.1a, b. In most cases deep liposculpture alone will correct most adiposities, producing an even retraction of the abdominal skin and thinning of the contours. **a** Preoperative; **b** postoperative

21.2.2 Technique

After the anesthesia has taken effect, the abdomen is divided into four quadrants, making it easier to compare the amounts of aspirate removed. Every full syringe is decanted and the total aspirate, as well as the amount of pure fat, is recorded. It is preferred to start with deep liposuction, close to the muscle with a 4.6-mm or a 3.7-mm gauge cannula and as the skin is approached finer cannulas, 3 mm or 2 mm gauge, are used.

Preoperative photographs are obtained in all patients in the standing position to use as a reference in the operating room to evaluate the asymmetries. The regularity of the suction is checked using with the pinch test or the outstretched hand.

Some patients need some skin resection as well as fat aspiration. They may not, however, be candidates for a classic abdominoplasty. In the past mini-abdominoplasty was used with the combination of liposculpture and dermolipectomy. But because of the high incidence of seroma with this combination, the patient was aspirated first and the skin resection postponed to a second procedure.

Some plication is performed without dissecting the whole flap. The excess skin is removed, the incision sutured, and liposculpture performed at the same time with less risk of seroma formation and necrosis. If the patient has excess skin in the epigastrium, skin resection bilaterally in the inframammary fold can be an option. If the umbilicus needs to be repositioned it can be cut from its fascial insertion and "floated" down a few centimeters, helping to eliminate unwanted supraumbilical wrinkles.

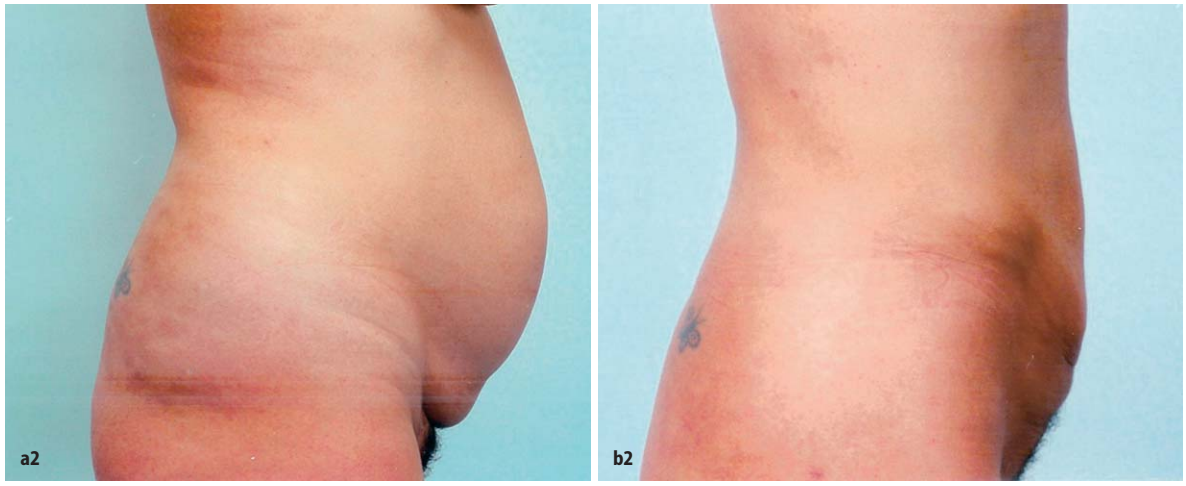

Fig. 21.2 a, b. Deep liposculpture producing improved contours and flat abdomen. **a** Preoperative; **b** postoperative

It is also possible, as described by Avelar, to remove the ellipse of skin from the umbilicus to the pubis, as in the classic abdominoplasty. Perhaps this procedure will substitute for the classic abdominoplasty in the future.

When a patient needs extensive skin and fat resection, muscle-aponeurotic plication and umbilicoplasty with the classic abdominoplasty is the treatment of choice. Not as many patients today need this kind of procedure, which was so popular in the past. It is usually indicated for the older, obese patient, or when there are diastases or hernias to solve the abdominal protrusion. The flanks and pubic area are aspirated during the procedure but liposuction of the abdomen itself postponed. The Callia technique is the author's choice when there is an indication for the classic method. One advantage is that the incision can be adapted according to the patient's preference for underwear or swimwear. When the technique was developed in the early 1960s, the fashion would favor hipster's jeans and St. Tropez bikinis. Today there is a preference for the high incision due to the French cut bathing suits and underwear.

21.3 Anesthesia

For a small liposculpture there is no need for heavy sedation, oral midazolam, 15 mg, being sufficient. For larger cases the anesthesiologist performs sedation with midazolam, fentanyl, and propofol. Midazolam is used in doses of 0.1 mg/kg intravenously (i.v.). The maximum dose is a total of 0.3 mg/kg depending on the patient and

the procedure. Midazolam's action is antagonized with flumazenil in doses varying from 0.2 to 1.0 mg i.v. Propofol is used in subdoses of 15 – 30 µg/kg/min.

For local anesthesia, a tumescent solution is used [8] with 20 cc of 2% lidocaine, 5 cc 3% sodium bicarbonate, 1 cc adrenaline 1:1,000, and Ringer's lactate q.s.p. 500 ml [11]. Up to 1 l of this solution is injected into each flank at body temperature (37°C) and up to 2 l into the abdomen. Liposuction is started after 10 – 15 min.

21.4 Instruments

The author uses 60 cc Toomey-tip syringes with zirconium-fused cannulas. Plunger locks will keep vacuum in the syringe. Transfers are used to pass fat from one 60-cc syringe to another anaerobically. For anesthesia injection, a 2-mm or 3-mm gauge, 35-cm-long multiholed tip needle is used. Fat is aspirated with 2-mm- to 4.6-mm-gauge cannulas, 25 – 35 cm long. Irregularities and release of old scars are treated with the 3-mm gauge V-tip Toledo dissector-cannula. A flat-tip two-hole, 5-mm gauge cannula is used to liposuction fibrotic fat areas. Zirconium cannulas cause less friction during the aspiration, making it easier to aspirate and with less damage to the fat cells needed for reinjection.

21.5 Patient Position

To avoid sterilization breaks during the change of position, the patient is prepped standing and will lie down on a sterilized operating table. The flanks are treated with the patient in the lateral position. The abdomen is placed in the hyperextended supine position, an additional precaution to prevent perforations of the abdominal wall.

21.6 Dressings and Postoperative Care

Micropore dressings with gauze are placed on the liposculpture incisions, which will drain the anesthetic fluid for the first 24 h. An abdominal binder or girdle should be used for a month. Manual lymphatic drainage is performed by the estheticians, starting 24 h postoperatively, two to three times a week, in order to diminish the swelling and provide comfort.

Patients are given 2 g i.v. of cefalosporine in the operating room and every 2 h up to 8 g in the first day. Oral azytromicin, 500 mg, is prescribed for 3 days. Patients can begin walking the next day, start driving on the fifth or sixth postoperative day, and start strenuous exercising and sunbathing after 1 month.

21.7 Conclusions

Syringe liposculpture of the deep (lamellar) layer of fat will solve most problems of localized fat of the abdomen and flanks. If the tissues are flaccid, with the need for skin retraction, I will use superficial liposculpture. If there is flaccidity with the need for skin resection, superficial liposculpture is used combined with removal of suprapubic or submammary skin flap. One of the main concerns of the plastic surgeon and his patient is the reduction in the length of the abdominoplasty scar. Patients with flaccid skin are offered the opportunity of choosing between an improved shape with no scars (liposculpture), and an optimal shape utilizing liposculpture combined with skin resection, a procedure with an incision. Patients are also aware that they can opt for a second liposuction after 6 months, when the healing process allows it, to improve the result of the first procedure, when needed. The classic abdominoplasty is indicated for selected patients.

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22 Megaliposculpture and Therapeutic Megaliposculpture

Pierre F. Fournier

22.1 Introduction

Ten years ago, we proposed the name "megaliposculpture" for all liposculpture procedures during which is extracted 10 l or more of a mixture composed of the adipose tissue, the normal saline from the subcutaneous infiltration and the patient's blood. The proportions of each of these elements vary according to the case, and only the quantity of adipose tissue will be taken into consideration.

The evaluation at the time of the hemoextraction, the visible fraction of blood loss that determines whether to proceed with or abandon the intervention, is of such importance that it is necessary to keep a close watch over this parameter. Its qualitative and quantitative importance determines the volume of pure lipoextraction.

At the time of his initial demonstration in Paris in March 1977 at the Muette Clinic, Giorgio Fischer, father of this technique, declared before the observing surgeons that lipoextraction (the name given to this operation at the time) was not a treatment for obesity, and he had conceived this technique, since he was himself a cosmetic surgeon, solely as a part of the cosmetic surgeon's armamentarium to treat only localized adipose parts of the body. He offered to his colleagues, pure cosmetic surgeons, a closed operation that eliminated the dermolipectomies (proposed by Ivo Pitanguy) in many cases, thus making it a preferred procedure.

The closed technique of lipoextraction avoided the long scars and, at the same time, transformed dermolipectomy (a procedure equally designed to modify the shape of the body and not excess weight) into a procedure of lesser importance. Nevertheless, the idea readily occurred to everyone, both surgeons and patients, to use this procedure to treat obesity and to think about extracting large quantities of adipose tissue, even if this treatment concept only dealt with the consequence of being overweight, and not the cause of obesity itself.

This concept of Giorgio Fischer, creator of the technique, and the conditions in which the procedure took place at the time (hospitalization, frequently general anesthesia, the use of large cannulas and machine, the absence of infiltration – "dry technique" or infiltration without adrenaline, a large number of blood transfusions, sometimes laborious fluid and electrolyte balance, hypovolemic shock, long convalescence, lack of practice by surgeons, complications or unsatisfactory results, lack of procedure updates) made surgeons fear that a lipoextraction of more than 2 l was the cause of the difficulties of resuscitation and of more frequent and more serious problems. The taboo of 2 or 2.5 l arose from this fact, and the extractions of 5 – 6 l from time to time were considered to be exceptional.

Little by little, the quantity of adipose tissue extracted increased, when it was certain that large extractions would not pose any additional risk to patients who were candidates for such operations. With Nestor Asurey as my assistant, we first practiced megaliposculptures in two stages at 6-month intervals: 8 l was extracted from the lower extremities during the first stage, and 6 months later 6 – 8 l from the abdominal wall.

After the cap of 8 l, corresponding to 6 l of pure adipose tissue, we reached the limit of 10 l for a large number of patients, then that of 12 l, then 14 l, then 16 l, then 18 l, then 20 l and so on, until a maximum of 23 l, corresponding to about 17 l of pure adipose tissue.

This quantitative work was spread out over 10 years and it was found to be greatly stimulated by identical work performed almost simultaneously by our colleague M. Eed in Saudi Arabia and A. Fikioris and G. Ioannidis in Greece, who treated similar cases to ours and used the same technique. In this way, little by little, the taboo of 2.5 l was destroyed and was replaced by confidence in megaliposculpture. This must only be performed by a surgeon trained in megaliposculpture, selection of patients must be carefully done, and the anesthesiologist must be trained for operations on obese persons, and must work in coordination with the surgeon and his team. Both the anesthesiologist and the surgeon must each know when to stop before going too far, and never pose greater risks to the patient than would be possible during the course of a standard liposculpture.

More than 800 cases have been operated upon to this day without mortality by the following surgeons who currently practice this operation: Drs. Eed, world lead-

er in this kind of surgery, Fikioris and Ioannidis; and all those who followed us: Carson Lewis in California, Giorgio Fischer in Rome, Furio Ferrari in Torino, Yelda Felicio in Brazil, Louis Madgdi Fanous in Abu Dhabi, Cesar Morillas in Peru, Hernandez Perez in El Salvador, Eduardo Krulig in Venezuela, and Louis Benelli in Paris. This permits us to be optimistic even if, sooner or later, as in any surgical operation, a serious complication should arise.

22.2 Why Perform Megaliposculpture?

Failures in current medical or surgical therapies for the obese justify megaliposculpture. Although the cause itself of the obesity is not treated by this megalipoextraction of adipose cells, the target is reached, but only in part, since lipectomy is only concerned with superficial excess and not the deeper excess of adipose tissue.

A certain part of hypertrophied or hyperplaised adipose cells are definitively removed from the catastrophic influence of the cause of the obesity. In this way, one can expect an improvement in the physical condition of the patient while provoking disturbances in the generative process of the obesity. One could compare this disease, obesity, to a war in which there is one enemy and several victims. If a counterstroke leading to victory is not possible, the first thing to do is to protect the victims, or at least, in the case of obesity, to shield them from the catastrophic action of this cause.

In this way, one can expect that the lesser the quantity of vulnerable tissue subjected to the disastrous cause, the better the body can fight against this biologic and metabolic anomaly. This attempt to reduce the vulnerable tissue territory can expect the attenuation of potential life-threatening consequences of obesity.

It is well known that obesity can cause or aggravate cardiac diseases, high blood pressure and stroke, pulmonary diseases, diabetes, gallbladder disease, gout, certain cancers, osteoarthritis of weight-bearing joints, an abnormal level of lipids and plasma lipoproteins, and irregularity of the menstrual cycle. Obesity is often an enormous psychological burden. When all the conventional treatments have failed, megalipoextraction is the last operation to perform. It should be regarded as a major lifesaving operation and not as an esthetic procedure.

The goal of megaliposculpture or therapeutic megalipoextraction is:

1. To extract in a single operation the greatest possible quantity of subcutaneous adipose tissue for the patient, without running a greater risk than in the course of a normal liposculpture, and without needing to perform any type of blood transfusion (autologous or not): the result of this operation is a numerical reduction of the subcutaneous adipose cells.
2. To provoke biological metabolic or psychological modifications in the operated patient, who, following a diet, exercise, or medical treatment, will result in decreasing the intra-abdominal and intramuscular adipose tissue, residual components of the excess adipose tissue. The result of these postoperative biological modifications is a reduction in the volume of the adipose cells in these two areas where a mechanical reduction is impossible to perform.

22.3 Indications

Megaliposculpture is a major operation that can produce serious complications and is selected only after thorough reflection by both patient and surgeon. Potential patients are failures of other medical or surgical treatments. The patient must be informed of the risks and is asked to reflect for a period of time.

In the beginning, we operated on patients weighing between 100 and 150 kg with no co-morbidities, e.g., high blood pressure, cardiac or pulmonary problems, or diabetes. Eventually we operated on patients over 150 kg, the heaviest patient weighing 210 kg. It was his insistence that made us decide to operate. The ideal patient does not exceed 100 kg; it is with them that one achieves the best results.

At the present time, we accept, with the agreement of our anesthesiologist, certain obese patients who also have high blood pressure, cardiac, pulmonary, or diabetic problems, if the risk does not appear to be too great.

Our results indicate that megaliposculpture will not bring a solution but an additional treatment for people with obesity, high blood pressure, certain cardiac or pulmonary problems, and other problems associated with obesity. In certain cases of ambulatory difficulties, in cases of vertebral osteoarthritis or arthritis of the hip, an abdominal megaliposculpture can reduce chronic vertebral pain, chronic pain in the hips or knees, or, as orthopedic surgeons have suggested, it might prolong the life of hip prostheses by removing the excess weight.

Having obtained positive results, we became more and more venturesome in the operative indications. We are convinced that the megaliposculpture has a place in the treatment of obesities, whether general or regional.

Infecting sterile air with a 60cc syringe after taping as suggested by Mel Shiffman shorten considerately this complication.

22.4 Technique

22.4.1 Anesthesia

Therapeutic megaextractions are done under general or epidural anesthesia. We prefer epidural, which is the least toxic for the obese patients and permits them to be moved without risk, if necessary. However, general anesthesia is often requested by the patients, even if they are informed that it is slightly more risky and that there will be more bleeding. The anesthesiologist must be accustomed to operations on obese people and be trained for this type of operation, which is completely different from the current cosmetic liposculpture. The anesthesiologist and the surgeon work in close collaboration with each other [2].

Once the actual operation has been completed, the surgeon must monitor the operated regions and must take part in the follow-up. Our anesthesiologist has the major responsibility for the patient's fluid and electrolyte balance, and the monitoring of the vital functions. His role during a megaextraction is of utmost importance in the selection of the patient, the resuscitation, the follow-up of the operation and the convalescence.

22.4.2 Surgical Technique

This is obviously preceded by the physical and psychological selection done by the surgeon and anesthesiologist. The megalipoextraction is possibly due to a large amount of normal saline. We have learned that it is possible to inject into the subcutaneous area 10, 15, or even 20 l of a normal saline that is cold at 2°C, and each liter can contain 1 mg of adrenaline (1 ml of 1:1,000). This amount of normal saline allows us to avoid postoperative hypovolemia and considerably limits pre- and postoperative bleeding.

22.4.2.1 Technique of Subcutaneous Infiltration

The operation begins as soon as the epidural anesthetic has taken effect or immediately after induction of general anesthesia. The surgeon will do this by himself, or, as is more often the case, with the assistance of an operating assistant who must be equally competent.

The only syringes used are the 60-cc syringes with a Luer-lock tip fitted with a cannula of 2.5 mm external diameter and 28 cm length. A second assistant will fill them in a basin that contains several liters, and will hand them over to the operating surgeons. The infiltration is made in the thick part of the subcutaneous tissue, and is a retrograde injection, each operating surgeon injecting symmetrical locations drawn in advance.

Quick infiltration should be avoided. It must be done in about 30 min, or longer if the area to be operated on is very extensive. The infiltration will be done at one time, or, if the area is extensive, in three sequential separate times, allowing 1/2 h between infiltration and lipoextraction. The first infiltration will be in the abdomen, then the sides, the thorax, the gynecomastia, then lastly the hips, outer and inner thighs, the front of the thighs, and the knees. The head of the operating table is elevated 15°. The four handed operation will begin as soon as the abdomen is ready to be operated on, i.e., 20–30 min after the end of the infiltration. An infiltration machine could also be used but we prefer to infiltrate with syringes.

During the abdominal operation, a third assistant will inject the second region to be operated on, the upper body and the sides, which will be ready for operation when the abdominal part has been completed. Finally, while the surgeon and his assistant are operating on the second region, the third and the last region is injected. We have injected up to 10 or 12 l of cold normal saline with adrenaline at one time before operating with no major complications. Even so, the occasional occurrence of arrhythmia has made us prefer, in the case of large injections (more than 8 l), to inject the areas to be operated on at two or three intervals. An intravenous drip of normal saline is instituted at the beginning of the operation; only 1–2 l will be given during the course of the operation; this is very important. There is no reason to start this intravenous rehydration in the preoperative period even though certain surgeons do. Fatal complications happened when too much fluid was given intravenously as well as subcutaneously [3].

22.4.3 Operative Technique

The operation is done exclusively with the aid of 60 cc plastic Toomey syringes. The vacuum machine is not used and could be even harmful in the cases of esthetic liposculpture and even more so during a therapeutic megalipoextraction. We use 60-cc syringes mounted with cannulas of 4 or 5 mm external diameter. The French model of the cannula, passing through the barrel of the syringe, is preferred to the American tulips, fixed externally on the end of the syringe. In order to lock the plunger of the syringe during an extraction, a groove in the form of a hook is made on one of the wings of the plunger of the syringe.

This system of locking the plunger allows us to avoid the use of metallic, heavy, cumbersome, and useless locks. This instrument is therefore light and thus does not "scrape" the adipose tissue, as did the cumbersome and heavy instruments when the machine was used (an operation during which there was significant pre- and

Fig. 22.1. Two surgeons extract and one other exchanges full syringes

postoperative bleeding, as confirmed by Vladimir Sidor our anesthesiologist in a hematological study [2]).

A light instrument is more enjoyable, more efficient, better controlled, and less fatiguing for the surgeon. In order not to lose time, one will have on hand four systems of cannula syringes with intrinsic lockage, and one will commence the operation after having waited 30 min once the injection has been made. Once the syringe is filled, each surgeon will exchange it for another cannula-syringe unit prefilled with 5 cc of normal saline, which will be given to him by a third assistant. The role of this assistant is solely to empty and fill in advance the syringes that he takes or that he returns to the two operating surgeons. It takes about 10 s to fill a 60-cc syringe.

This method with two operating surgeons and one assistant (Fig. 22.1) allows a considerable amount of time to be gained and is much more rapid than the machine technique, and overall does not have one of the disadvantages of pre- and postoperative bleeding, which becomes more important without the buffering action of the 5 cc of normal saline which is present in the syringe at the moment of the extraction.

An average operating surgeon will extract about 5 l/h. Thus 2 h is necessary to extract 20 l (Fig. 22.2). The injection itself and the time waiting for it to take effect takes 1 h. The preparation of the patient and the epidural anesthesia takes another hour. The preoperative drawing which determines the operating regions in exactly symmetrical zones permits each operating surgeon to do his job efficiently, rapidly, and of identical quality. The work of the first assistant must replicate that done by the principal operating surgeon.

Throughout the entire operation, the anesthesiologist will inform the surgeon of all possible variations in vital functions and assure fluid and electrolyte balance of the patient. The operation must also be as minimally hemorrhagic as possible. A prolonged extraction that is too bloody will force the procedure to be stopped. Sometimes it will be necessary to turn the patient over,

Fig. 22.2. Extraction of 20 l of adipose tissue – use of 14 l of cold normal saline, 1 mg of adrenaline per liter

which will be done with the usual precautions. The operating table is head-up at 15° during the entire operation. The extraction will be done according to the usual criss-cross technique.

Once the operation has been terminated, the cutaneous penetration points are sutured, and the elastoplast bandage (strips 10 cm wide) is used unless one uses the elastic garment right away. The patient will then remain in the recovery room under strict observation for 2 h before being taken back to his room.

During the majority of large lipoextractions, the megaliposculpture was interrupted when there was no more subcutaneous adipose tissue to be extracted. In the regions that were completely treated, the residual excess of the patient's adipose tissue was represented only by the intra-abdominal or intramuscular adipose tissue. Even for a patient weighing 210 kg, once 21 l had been removed, the operation had to be interrupted since almost the entire subcutaneous tissue had been extracted. This demonstrates the importance of a postoperative dietary regime, as the problem is not entirely solved by a single surgical operation.

22.5 Follow-up and Postoperative Care

In his room, the patient is kept in a semirecumbent position, in order to facilitate easy breathing and to avoid compression of the diaphragm muscle. The same evening the patient will sit up, and as soon as able, he is recommended to move his legs several times per hour and to breathe deeply.

The postoperative monitoring (electrocardiogram, pulse, blood pressure) is maintained for 24 h. The epidural catheter is maintained for 24 – 48 h, and only the anesthesiologist decides when the analgesic solution should be injected. The urinary Foley catheter is maintained for 24 – 48 h. Temperature and urine output are monitored, as well as hemoglobin, serum proteins, and electrolytes. The anesthesiologist must be accustomed to such operations because hemodilution can persist for several days. Antibiotics are routinely administered (Vibramycin 100 mg b.i.d. for 5 days), as well as anti-inflammatories (Reparil or Extranase, two pills t.i.d.). In our patients, fluid and electrolyte balance is done by the anesthesiologist. In general, one gives either 1 l of normal saline or Ringer's solution every 6 h for 2 – 3 days.

The surgeon observes the dressing that sometimes needs to be changed due to light bloody saline discharge. The importance of this discharge should be explained before the patient's operation in order to avoid useless worries. It is psychologically beneficial to tell the patient that the greater the discharge, the better the postoperative result and the less residual edema. Thus the patient views this unavoidable discharge favorably.

22.6 Results

In the days following the operation, an inflammatory reaction occurs that lasts 6 – 8 weeks. The operated tissues will harden and become sensitive, which is completely different from the immediate postoperative period when they were soft.

When the bandages are changed after 24 h, the modification of the silhouette is impressive (Fig. 22.3). Then, over a few days the inflammatory reaction begins and the patient finds himself with the same configuration as in the preoperative period. It is this inflammatory reaction that explains why the patient's weight is not modified in the first few weeks.

It is not until 2, 3, or sometimes 4 weeks that the weight loss will begin. It will be more or less rapid right away, but it varies from one patient to the next. It is also associated with a softening of the operated tissues that become less tender, allowing the patient to move more easily. The urine output also increases considerably.

This weight loss will be approximately equivalent to the weight of the quantity of adipose tissue that was extracted. It is after this weight loss begins that it is determined whether the patient should follow a diet. In about 20 % of patients, the weight loss in the months following the operation is less than the quantity of adipose tissue extracted.

The majority of patients noticed a sudden loss of appetite that lasts several months. Whatever its origin, whether psychological or due to metabolic modifications, it is very frequent.

Fatigue is variable from one patient to another, and is not necessarily linked to volume of blood loss. The drop in hemoglobin is not as important as one would think. Megaliposculptures of 15 l do not vary the hemoglobin level by more than 1 g. The drop can sometimes be greater than 1, 2, or 3 g, but one must take into account the hemodilution that makes the appreciation of the true blood loss difficult. Strict iron therapy is, however, routine for several weeks.

The hospital stay varies from 2 to 5 days according to the patient. Following discharge from hospital, convalescence of 1 week is necessary. Normal activities may be resumed 10 – 15 days after the operation.

Aided by a nutritionist, the patient commences dieting after 8 – 10 days. Iron supplements, vitamin C in normal dose, and a high protein diet are recommended. The patient will see the surgeon at frequent intervals.

22.6.1 Complications

Moderate anemia, fatigue, and a loss of appetite may occur postoperatively. It is unavoidable that a large ex-

Fig. 22.3. a Preoperative; **b** one year postoperatively. Excellent skin retraction

traction of adipose tissue causes localized as well as generalized reaction, and a patient that cannot understand this should not be operated on. The psychological motivation of the patient is indispensable for a favorable outcome. It is a question of an operation that is therapeutic and not esthetic even if esthetics play a role. The goal is to obtain an almost certain weight loss due to the lipoextraction, that is followed in most patients by a second weight loss which is related to dieting, exercise, and to therapeutic medication administered postoperatively.

22.6.1.1 Local Complications

In three patients on the abdomen a moderate cutaneous necrosis of a few square centimetres occurred, attributed to a liposculpture that was too superficial. This healed in a few weeks. We had a larger one on the thighs, taking 2 months to heal, the patient refusing a skin graft (Fig. 22.4). Surface irregularities, excess of skin and depression of the adipose tissue are treated by dermolipectomy if the patient wishes after 6 months, but few patients ask for it since cutaneous retraction is good or the patients do not want to be treated.

A normal appearance is often noted spontaneously because of the thinning process postoperatively. Before the operation the patient is duly informed of the possible local esthetic discrepancies and the possibility of eventual surgical operations.

Fig. 22.4. Skin necrosis on the thigh, healing in 2 months – patient refusing skin graft

When working on the abdominal region, we had several lymphatic effusions. They are frequent when the megaliposculpture reaches 15, 17 or 20 l. One can notice them on the third postoperative day. They disappear after 5 – 6 weeks, and can be tapped 2 – 3 times. The quantity extracted varies from 1 to 3 l. We have not had an infection in between the punctures. Patients have moderate compression by the elastic garment postoperatively and also antibiotics.

22.6.1.2 General Complications

We have not had hypovolemic shock due to the pre- and postoperative fluid and electrolyte balance. Aside from the cold saline injections, the intravenous therapy is left entirely to the anesthesiologist. This intravenous is discontinued 24 – 48 h after the operation.

In one patient, acute pulmonary edema occurred the night following the operation. Blood-letting of 1 l rapidly improved the condition of this 150-kg patient from whom 15 l had been extracted without difficulty. The 15-l lipoextraction corresponded to the essential excess of subcutaneous adipose tissue from the abdomen and thorax, the remaining excess being mostly intra-abdominal. The patient left the hospital on the 4th day, and when he returned 6 weeks later, he had lost 26 kg.

The analysis of this unusual and dramatic complication was a learning experience. The obese patient was breathing mostly with his diaphragm and little with his ribs, which were laden with adipose tissue. The cause of this acute edema appeared to be due to the abdominal bandage made of elastoplast strips that were unintentionally too compressive, and also due to the strictly horizontal position of the patient in his bed. This excessive compression and the vertical pressure due to the weight of the intra-abdominal internal organs (where excess blood had accumulated) considerably hindered the movements of the diaphragm, further accentuated by the strict horizontal position of the patient on the operating-table and then in his bed.

The 15° head-up position of the operating-table has subsequently been adopted as a matter of routine. Also in the bed, this semi-recumbent position is maintained long after the operation. The bandaging should be occlusive but not compressive. One could think that this acute edema was due to a fluid excess, due to the 8 l of normal saline that was injected subcutaneously. However, we have injected in all patients large quantities of normal saline at 2°C (with 1 mg of adrenaline per liter) and sometimes up to 21 l, without problem.

We have never experienced complications due to the utilization of normal saline at 2°C. Sometimes we register a moderate decrease in the central temperature of 0.5°C in the postoperative period, but without serious consequences. The 2°C cold saline injection produces a better quality anesthetic than with a pure local anesthesia, either classical or using Klein's formula, and above all a more important local vasoconstriction.

The work of Nestor Asurey in Buenos Aires on the white rat demonstrated this. One side of the femoral pedicle of a white rat was dissected and moistened with an adrenaline xylocaine solution at 2°C while the other femoral pedicle was equally dissected and moistened with an identical adrenaline xylocaine solution, but at room temperature: 22 – 23°C. The examination of the pedicles under a microscope demonstrated that in the side that was moistened with the solution at 2°C, the arterial vasoconstriction was more rapid, intense, and prolonged than on the opposing side where the solution was at room temperature.

22.7 Discussion

Giorgio Fischer in Rome in 1974 used a specially built suction machine and blunt cannulas of different diameters for the extraction of adipose tissue from localized fat deposits on the body. The equipment used was simplified in 1977. The abortion cannulas and suction machine of Karmann allow the surgeon to perform a procedure identical to Fischer. In 1985, 60-ml plastic syringes were used, and a special cannula passed through the syringe mounted on the tip of the barrel. For many surgeons, the syringe replaced the suction machine. Lipoextraction was simple, efficient and more rapid.

Liposculpture is indicated for patients having excess fat in some part of the body. It was considered that extraction greater than 2 or 3 l appeared too risky. However, over the past 10 years, we have increased the amount of adipose tissue extracted. To achieve this, the surgeon has to inject large amounts of normal saline at 2°C with epinephrine (1 mg/l). The lipoextraction is performed with 60-ml syringes by one or two surgeons to decrease the duration of anesthesia. Up to 20 l of adipose tissue mixed with normal saline and some blood can be extracted in one session without blood transfusion.

In most patients, we only inject between 5 and 10 l, and in only a few patients have we injected 15 – 20 l. It appears that adrenaline is quickly metabolized after the injection. In many cases we inject in two or three stages during the operation to avoid major modifications in blood pressure.

Our specific indications are patients between 100 and 130 kg without major diabetes, high blood pressure, heart or pulmonary disease, who have tried diets, and medical and surgical treatment without success. Patients should understand that this is not intended as an esthetic procedure, that complications may occur, and that "touch-up" may be necessary as well as other operations to get rid of skin excess, should it occur. Lipoextraction can be performed in patients with a maximum weight of 160 kg, but these patients should understand that the risks of the operation are slightly increased.

Contraindications are: (1) patients who have never tried dieting, exercise or medical treatment; (2) patients who do not understand that this is a major procedure, and that there are some risks, and that a "touch-up" or a

future skin resection may be necessary; (3) patients who have serious disease secondary to their obesity.

My colleagues and I have lost contact with many patients, as they live abroad or do not return for follow-up. Our main goal has been to prove that major amounts or subcutaneous fat can be removed with minimum risk and without blood transfusion. The complications that we had have been accepted by our patients who understood that it was a life-saving operation and not a cosmetic procedure.

Gastrointestinal operations for massive obesity have significant morbidity. In the long term, regain of weight

Fig. 22.5. a Preoperative; **b** 1 year postoperatively with loss of 22 kg

Fig. 22.6. a Preoperative; **b** 9 months postoperatively with loss of 27 kg. Result maintained after 6 years

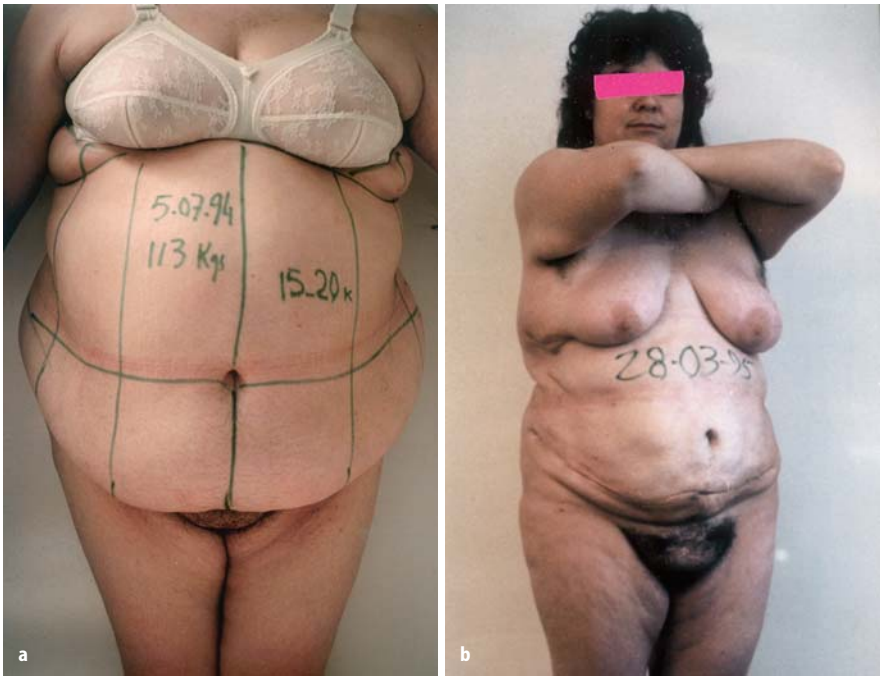

Fig. 22.7. a Preoperative diabetic and hypertensive with high cholesterol; **b** postoperative results after 7 years with loss of 22 kg. Blood sugar is normal, cholesterol level is normal, and blood pressure is normal

may occur. All bariatric abdominal operations leave the fat cells in place that can once again hypertrophy if the cause of the obesity has not been suppressed at the same time. Only large dermolipectomies that are major operations reduce the number of adipose cells. They are burdened with a significant morbidity in the obese patient.

On the contrary, a closed megaliposculpture reduces greatly the number of adipose cells. This treatment is minor compared to large dermolipectomies.

If a large quantity of adipose cells remains and can once again hypertrophy, megaliposculpturing is the only moderately aggressive treatment compared to other techniques (Figs. 22.5 – 22.7). Although it does not treat the cause of the obesity, it considerably diminishes the quantity of the patient's adipose cells. Megaliposculpture has shown that large quantities of adipose tissue can be extracted without minimal risk and that large, localized obesity provoking a functional hindrance can be definitively improved or eliminated. It opens new horizons in the treatment of osteoarthritis of the lower extremities and possibly of the co-morbidities. This operation can be used to treat residual adiposities following gastroplasties or bypass procedures, and may be used for patients who have insufficient weight loss from dieting.

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Liposuction of the Abdominal Wall Followed by Abdominoplasty

23

Giorgio Fischer

23.1 Introduction

The history of cosmetic surgery of the abdomen starts back in the nineteenth century. Between 1890 and 1910, several authors described the technique of dermolipectomy. In 1957, Vernon [1] baptized the modern era of abdominoplasty using a combined technique of a low transverse abdominal incision together with an umbilical transposition [2]. Callia, in 1967 [3], described a similar technique with an incision that passed under the inguinal line. In the same year, Ivo Pitanguy [4] published his work on abdominal lipectomy. It was his experience that gave us the opportunity to understand the basic principles of abdominoplasty. Pitanguy's principles were simple and precise: small incision of the inferior abdomen and down through the inguinal line, transverse umbilicoplasty, reinforcement of the fascia, and postoperative bandages. In 1975, Regnault [5] introduced the "W technique". The incision started above the mons pubis and laterally went down following the inguinal line.

This shows that abdominoplasty techniques have varied throughout the years, and that with time the goal has been to achieve maximum results with scars that could have easily been covered by bikinis or by natural anatomical lines.

Unfortunately, the only concern of the patient seems to be the remaining scar. It has to be kept in mind that we are not general surgeons. Lives are not being saved and the patients are hardly able to accept evident scars. It is for this reason that the concept of modeling the abdomen has radically changed after the introduction of liposuction techniques. The abdomen is one of the areas that has most benefited from the introduction of liposculpture [6]. Until then the only option that was given to patients was dermolipectomy.

Besides the scar, which is sometimes very difficult to accept, abdominoplasty in the traditional manner is a very big operation. It probably needs hospitalization and several days of recovery. Medical preoperative evaluation is very important in order to detect the presence of hernias and possible diastasis of the rectus abdominal muscles. Another important fact to evaluate is the degree of intra-abdominal, visceral, or omental fat. This, in fact, will determine the outcome of the operation since only the abdominal wall fat will come out. Last, but certainly not least, abdominoplasty is not free from complications. The most frequent are certainly the formation of hematomas and seromas. These complications make the recovery period even longer and uncomfortable for the patients. Necrosis of the skin is the most unfavorable complication. Fortunately its incidence is low and occurs when the vascularization of the flap has been damaged during the operation. Superficial necrosis is, however, quite frequent especially medially in the suprapubic incision when closure is performed under great tension. Smokers are obviously high-risk patients for this complication.

23.2 Anatomical Considerations

The anatomical characteristics of the abdomen are very important to take into consideration. The surface anatomy of the abdomen can be subdivided into the epigastrium or upper abdomen, the hypogastrium or lower abdomen, and the mesogastrium or midabdomen, which contains the periumbilical and waist areas. The lower abdomen is delimited by two imaginary lines running one superiorly through the belly button, and one inferiorly through the mons pubis.

The anatomy of the subcutaneous fat can be subdivided into an apical layer which is very thin and extends into the deep reticular dermis, a mantle layer which is quite large but varies in thickness throughout the body, and a deep fat compartment layer [7]. This latter layer is responsible for the uncosmetic areas of fat excess.

The distribution of the subcutaneous fasciae is also very important in order to understand why certain areas of the abdomen appear so difficult to defat. The septae are the major responsibility for the presence of very fibrous areas, especially in the waist area and in the upper abdomen.

Camper's fascia is defined as the superficial layer of superficial fascia of the abdomen. It extends over the

entire area of the abdomen. Scarpa's fascia instead only exists in the lower abdomen with the upper insertion coinciding with the waistline fibrosis.

The upper abdomen appears to be more fibrous and harder to penetrate with a cannula probably because of the presence of numerous fibrous septae. This is why the upper abdomen, above all of the other areas of the body, has a high risk of postoperative wrinkles. Scarpa's fascia does not exist in the upper abdomen; therefore if too much fat is taken away there is no possibility that this fascia, existing only in the lower abdomen, may alleviate the adherences of the fibrous tissue to the skin.

23.3 Surgical Treatment (Figs. 23.1 – 23.6)

The choice of surgical treatment depends on the surgeon and obviously on the type of deformity of the patient. With the introduction of liposuction, the original

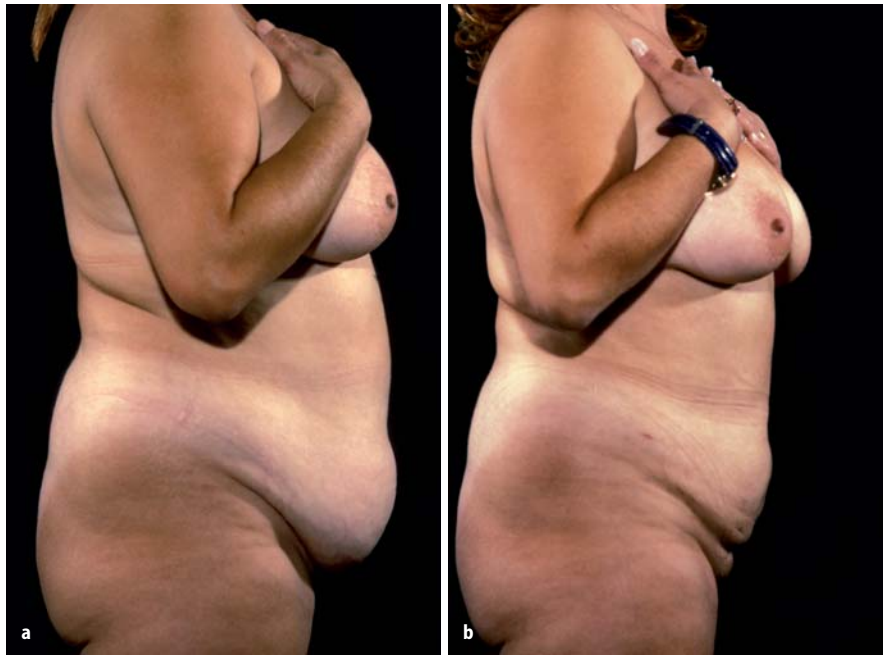

Fig. 23.1. a Preoperative patient with large fat deposit and excess skin. **b** Postoperatively good results with liposuction alone. Patient could have had an abdominoplasty but she was satisfied with the results

Fig. 23.2. a Preoperative type D patient with localized fat deposit and no skin excess. **b** Postoperatively excellent results with liposuction alone

Fig. 23.3. a Preoperative middle-aged patient (type B) who could have liposuction or abdominoplasty. **b** Postoperatively following liposuction only

Fig. 23.4. a Preoperative patient with excess fat and skin. **b** Postoperatively following liposuction. Skin retraction is not complete and patient can have a small abdominoplasty as a secondary procedure

abdominoplasty is now rarely required. The differences between patients have to be taken into consideration because abdominal liposuction is not ideal for every patient, especially when little fat is present with a large skin apron, extended stretch marks, and/or the presence of muscle diastasis. To these patients, whom I call Type A patients, I recommend an ordinary abdominoplasty. My Type D patient is a patient with no muscular laxity and an excess of fat in the abdominal area. This patient will undergo a simple liposuction of the abdomen.

Type B and C patients are those patients whom I call "boundary patients". My first approach is always liposuction, but I tell the patients that if the skin will not retract in the 6–8 months following the operation, they will need a mini tummy-tuck. It is very important to inform the patients of the various technical possibilities. It is very surprising to see that many patients to whom

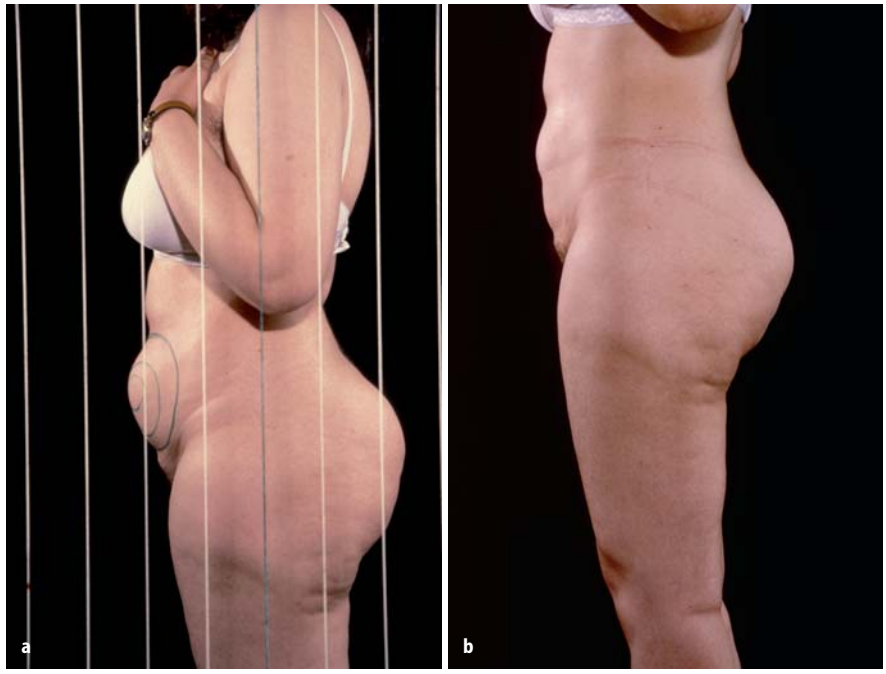

Fig. 23.5. a Sixty-year-old patient with localized excess fat. **b** Postoperatively following liposuction with good skin retraction despite age

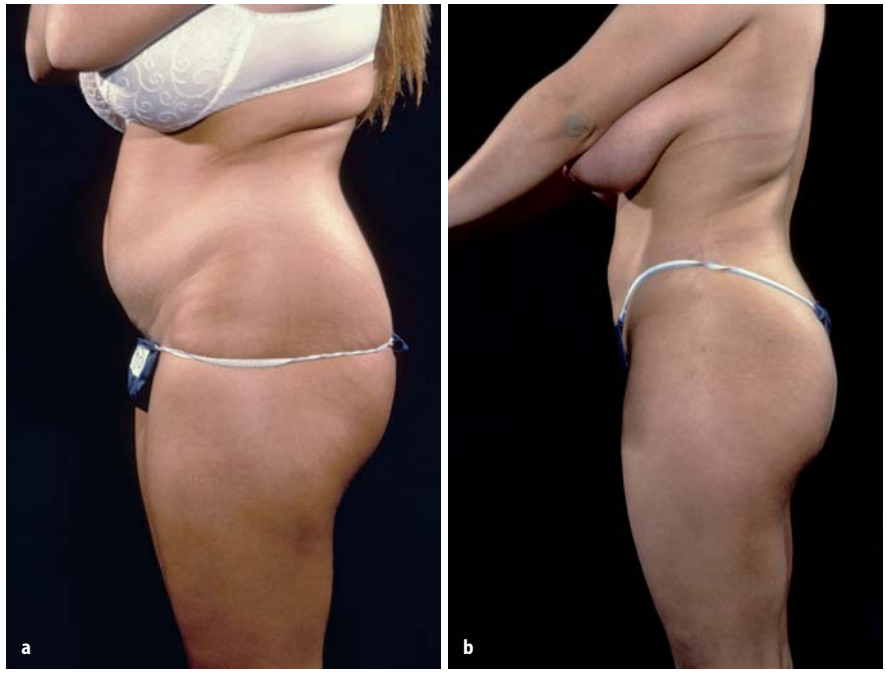

Fig. 23.6. a Preoperative patient with moderate excess fat and no loose skin. **b** Postoperatively following liposuction with excellent results

I had advised this two-stage operation were already satisfied with liposuction only. The abdomen in fact has excellent retraction capabilities, especially in young patients.

I never practice a one-stage operation. The first stage is always liposuction, and the second one, if needed, is a mini-abdominoplasty. The second stage operation is quite simple, and since the only remaining thing is the excess skin, there is no need for a very long scar, nor is there any risk of vascular damage as when large dermolipectomies are performed.

23.4 Liposculpture

Liposuction technique for the abdomen does not differ very much from that of other areas of the body. The ab-

domen is a very challenging area to operate upon and the silhouette can really be changed in a person. There are areas in which we must be very careful, such as the upper abdomen, where excessive defattening might result in rugosity after the postoperative edema has passed. This happens most often in older patients with decreased skin elasticity.

Preoperative evaluation of the patient is very important. The first thing to do is to make the patient lie down and lift her/his legs up, so that the abdominal muscles can be evaluated. In the case of severe diastasis of the rectus abdominal muscles, liposuction is not performed. Also, it is important to know whether the patient has a hernia, since there is a higher risk of intestinal perforation. It is also important to know whether the patient has breast protheses. After the examination, preoperative pictures are taken and the skin marked.

Once in the operating theatre, the anesthetist starts sedating the patient. General anesthesia is never used. All through the operation they must be able to contract their abdominal muscles if asked to do so. Too much relaxation will cause loss of the perception of the area being worked on.

Infiltrating of tumescent fluid is done using a modified tumescent technique. The amount infiltrated is as much as is determined will be removed. Real tumescent anesthesia infiltration [7] gives an excessive distortion of the fat, making it very difficult to sculpt the body. Liposuction is a sculpture of the body. I have fought for years against the force of gravity that kept me making the same mistakes, making it hard to see what the final result could be. When I invented the orthostatic bed, the statue in front of me could finally be seen as she would appear in everyday life. Infiltrating twice or three times as much, as I have seen many of my colleagues do, is a wrong approach for the technique. There is no need to do so. One should never lose sight of what is under one's hands. Therefore, if 1,000 cc of fat is estimated to require removal, only 1,000 cc is infiltrated.

It is important that the patient lie on the orthostatic bed. The abdomen, especially in young people, is one of those areas that must be treated in the orthostatic position. Many patients will tell you that when they are lying down, their tummy looks fine. Patients, nevertheless, never look at themselves lying down; therefore, you should always operate in the most natural and physiological manner. In the upright position you will have no false effects due to the force of gravity. The refinements are, therefore, carried out in an orthostatic manner. The first part of the operation may be carried out in with an oblique method.

When liposuction represents the first stage of a two-stage operation, most of the fat is taken away from the very deep fat compartment. It is only later that a superficial liposculpture is performed in order to help the skin retract.

Criss-cross tunnels are used for liposculpture. Generally four or five incisions are enough for the whole abdominal area. Do not be concerned about the number of incisions made. The only important thing is to work comfortably and to tunnel in the correct directions. Tunnelling should always be performed in a vertical manner. Two incisions are suprapubic. From the left one the cannula is criss-crossed onto the right side of the abdomen in a clockwise direction, and the opposite happens for the right incision. Remember to place the incisions in a non-symmetrical manner to give the appearance that they are other types of scars. Another incision is placed over the umbilicus. From this incision the cannula is criss-crossed right and left. Other incisions can be placed under the breast so as to tunnel in an opposite direction to the umbilical incision. Of course different situations require different incisions.

Always work on a wet surface. Only in this way can one really appreciate what is under one's hands.

I work with my left hand flat on the surface of the abdomen until I am concerned about the diminishment of the volume. Then I start pinching it in order to evaluate the thickness. A certain amount of subcutaneous fat should always be left; otherwise after the postoperative edema has passed, adherences to the muscle may be seen. You should always feel unhappy at the end of your operation thinking that you could have taken away more. Remember that a certain amount of fat reabsorption occurs after the operation; therefore the final result will not be seen at the operating table. As Illouz has said, "it is not so much what is removed that is important, but what is left behind" [8]. Good and expert surgeons are only able to imagine what the final result will be.

Because of the particular anatomy of the abdomen, I do a heavier liposuction on certain areas of the abdomen in order to give the patient a better silhouette. The midline between the costal margins contains a lot of fibrous tissue and fat and, at times, can be difficult to remove, but when possible more fat in that area is removed than in the surrounding ones in order give a "depression" effect. Patients want to look like body builders, and this turtle-effect of the abdomen makes the patient look thinner. Also, more fat is removed in the triangle above the mons pubis, beneath the umbilicus. This gives more roundness on the left and right sides of the lower abdomen, which gives a very nice feminine look to the abdomen. Accentuating the waist is a very important aspect of abdominal liposuction. Suction of the lateral upper hips can really change the silhouette of a person.

Recently I have started using a very simple instrument at the end of my operation. Before applying Reston foam, I smooth the treated areas with an iron steel tube. I roll the tube for about 10 min all over the abdomen with a certain amount of pressure. This smoothens and evens up the surface very well.

After the operation is completed, Reston foam is applied. I disagree with my colleagues who believe in the unsatisfactory results of Reston foam. It creates a uniform distribution of the pressure and prevents bruising very well. If you do not infiltrate too much you will not need loose garments which permit open drainages; in fact, I always suture the incisions. Over Reston, I make my patients wear a normal pair of elastic garments (70 den tights). Reston is removed on the third postoperative day. Patients are immediately sent to massage sessions that will continue for over a month, and even longer if needed. At the beginning they will have massages three or four times a week. This is very important especially when the abdomen is treated. The postoperative edema of the abdomen takes more time to resolve than that of other areas of the body. It is very important to massage the areas to reduce the probability of permanent lumps and long-lasting edema.

Patients are told not to sit at a 90 degree angle or to bend forward for too long. Sitting straight up or bent forward for a long time can cause wrinkles on the surface of the abdomen that will be very difficult to remove later on.

23.5 Conclusions

I believe that in the majority of our patients liposuction alone is able to give good satisfactory results. Liposuction has proved to be so effective that routine abdominoplasty is now rarely required. Only in the case of excessive skin, little fat, diastasis of rectus abdominal muscles, or extensive stretch marks, is abdominoplasty required. In all other cases, liposuction alone, if performed correctly, will give excellent results.

When liposuction alone is not enough, I never perform abdominoplasty at the same time. I carry out what is called a two-stage operation. When indicated, the second-stage abdominoplasty is carried out 6–8 months after liposuction. Generally there is no need for large scars if the flap has been well defatted. The operation can be carried out using local anesthesia.

Abdominoplasty alone is rarely indicated except for particular cases. The first approach should always be liposuction and the patient should be informed that another operation may have to be performed. Perfection needs time.

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Extensive Abdominoplasty and Large Volume Lipoplasty

24

Lazaro Cardenas Camarena

24.1 Introduction

Aesthetic surgery of the abdominal region is one of the most frequent surgical procedures performed in plastic surgery [1–3]. The increased utilization of this procedure is due to the fact that the abdominal region is one of the areas where the feminine figure undergoes more changes. These changes are due to two basic factors, which are common to women: flaccidity of the abdominal area produced by pregnancy and the accumulation of adipose tissue in this region. These factors are due to the anthropometric and hormonal physiological characteristics of women [4]. As a result, even the slightest weight gain is evident primarily in the thoracoabdominal area. When we speak about the thoracoabdominal area, we are referring not only to the anterior abdominal area, but also to the flanks, the lumbar region, and the supragluteal area. In all of these areas, the accumulation of adipose tissue is very marked in patients who have any degree of obesity. We can, therefore, point out that the thoracoabdominal area can be divided into two topographical regions according to the aesthetic alterations produced therein. These two regions undergo different changes, as well as differencing etiologic factors, thereby requiring a different aesthetic surgical management.

24.2 Surgical Anatomy

From the strictly aesthetic surgical point of view, the abdominal area encompasses laterally the mid-clavicular lines, superiorly the inferior mammary creases, and inferiorly the pubic region. A second area extends from the mid-clavicular lines posteriorly to the lumbar area, while being limited inferiorly by the gluteal region. This area thus circumferentially completes the thoracoabdominal region (Fig. 24.1). Within this second area, a considerable part of the anterior abdominal wall is encountered, which corresponds to the region between the mid-clavicular and mid-axillary lines (Fig. 24.2).

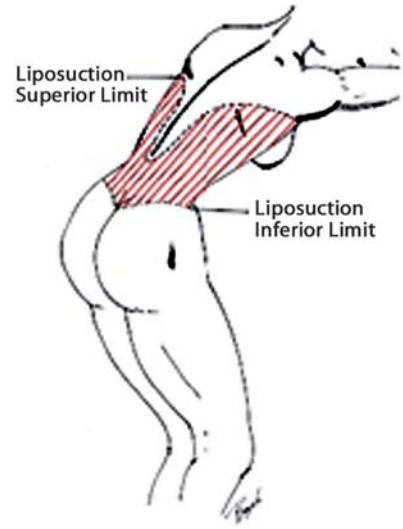


Fig. 24.1. Posterior thoracoabdominal region, limited superiorly by the scapular region, and inferiorly by the gluteal region

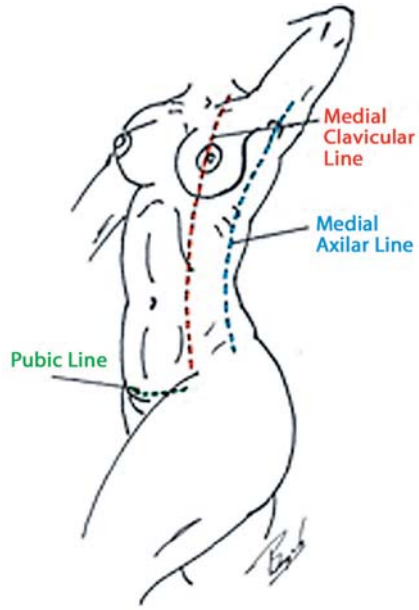


Fig. 24.2. Anterior abdominal region, included between the midclavicular line and the anterior axillary line, should be viewed as an annexed portion of the posterolateral region. As such, it should be treated with lipoplasty

The inclusion of the anterior lateral abdominal area is due to the fact that the aesthetic alterations and management are similar to the posterior region; thus we should surgically include it in this area. For that reason, the aesthetic surgical management of the abdomen includes a first area including part of the anterior abdominal region and a second area which is much more extensive and including part of the anterior abdomen, flanks, and the lumboscapular region. These areas will share two common structurally aesthetic changes, but in different proportions: firstly, the presence of tissue laxity with resulting flaccidity, and, secondly, the accumulation of adipose tissue, which produces lipodystrophy.

The initial change produced in these two areas is lipodystrophy. When it is moderate and the patient has not undergone any significant weight change, either due to pregnancy or obesity, the presence of flaccidity is minimal. On the other hand, if the patient presents a significant degree of obesity, significant weight change or multiple pregnancies, or with a large weight gain with pregnancy, the anterior abdominal area will become flaccid. Nevertheless, the rest of the thoracoabdominal area almost always undergoes lipodystrophy without significant flaccidity, even though the patient possesses predisposing factors for flaccidity of the abdominal area.

Fig. 24.3. Patient for which an ideal surgical indication is an abdominoplasty

24.3 Patient Evaluation and Selection

Taking into account these two surgical anatomical considerations, the patient should be evaluated beforehand to determine the ideal surgical procedure. When a significant degree of flaccidity of the anterior abdominal area is encountered, with or without lipodystrophy, the surgical procedure of choice is abdominoplasty [4] (Fig. 24.3). Abdominoplasty is a very safe surgical procedure with a low incidence of complications [5, 6]. On the other hand, if the anterior abdominal area displays predominately lipodystrophy without or minimal flaccidity, the procedure of choice is lipoplasty assisted by suction [7–9] (Fig. 24.4). This procedure when performed in an adequate and correct manner also is associated with a low incidence of complications [10–14].

On some special occasions, in spite of the existence of important lipodystrophy and flaccidity of the abdominal region, the exclusive use of lipoplasty assisted by suction may be utilized [13, 14]. This generally is indicated when the patient does not desire a large scar resulting from an abdominoplasty, or if the patient is nulliparous and/or desires future pregnancies. In these cases, although the results are not ideal due to the persistence of some abdominal flaccidity, the improvement is great (Figs. 24.5, 24.6).

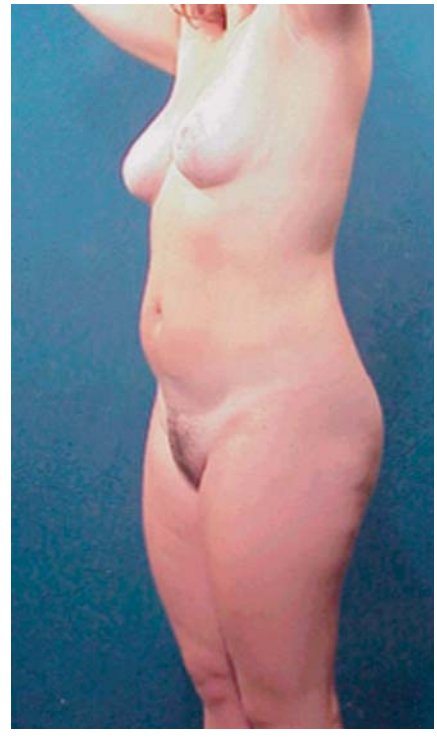
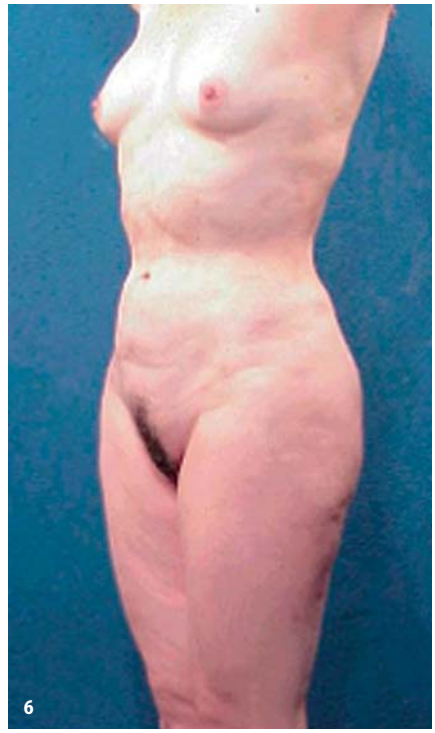


Fig. 24.4. Patient with indication for a lipoplasty to improve her body contour



Figs. 24.5, 24.6. Patient whose ideal surgical procedure is an abdominoplasty combined with lipoplasty, but was treated only with lipoplasty with good results

In the area included from the lateral abdominal region to the lumboscapular region, the procedure of choice almost always is lipoplasty assisted by suction. Even though the patient displays a great degree of lipodystrophy with very evident flaccidity, cutaneous retraction in this area is very good, and rarely is additional surgery required. Because of this, if a patient presents with significant flaccidity and severe thoracoabdominal lipodystrophy, the anterior abdomen should be treated with abdominoplasty, and the rest should be corrected with lipoplasty assisted by suction.

In fact, controversy exists over the manner in which these two procedures should be performed. Many authors prefer to perform these procedures separately in order to diminish morbidity [15, 16]. Nevertheless, there are authors who report a low incidence of complications utilizing abdominoplasty combined with other procedures, such as gynecological, abdominal, or aesthetic surgery [17–22]. At the same time, there are other authors who utilize abdominoplasty combined with liposuction with very good results [23, 24]. We prefer to combine both procedures, but in contrast to previous authors, our area of lipoplasty and the amount of fat extracted is greater than in their reports. The reason for combining the procedures is the fewer complications reported for each procedure [23, 24], and the low number of complications when using the combined procedures [17–22]. Equally our means of extracting large quantities of fat is based on multiple large volume lipoplasty studies showing good results and few complications [13, 25–27], and also our experience with this type of procedure [14, 28]. Therefore we use a complete abdominoplasty in conjunction with lipoplasty, extracting large volumes during the same surgical procedure, but always following certain principles in order to maximally avoid complications.

24.4 Surgical Technique

After surgical selection, an internal medical specialist evaluates all patients. The patient's laboratory tests are evaluated, which include a complete blood count, prothrombin time, coagulation time, and a complete urinalysis. If required, the patient undergoes a cardiologic evaluation, including a PA (posterior anterior) chest X-ray, and electrocardiogram. In order for a patient to undergo surgery it is required that no abnormalities are found during the medical evaluation, or that any abnormality be completely controlled, thus not adding to the morbidity of the procedure.

In all those patients who are considered for extraction of fat during liposuction larger than 8 l, 500 ml of blood is drawn 10 days prior to the surgical procedure. This blood is used during the postoperative period in an autologous manner. All patients are given 1 g of cefalexin as a preoperative prophylaxis 6 h prior to surgery. Surgical operative areas are totally marked preoperatively with the patient standing. The area where the abdomi-

noplasty procedure will be undertaken is delineated, as well as the suction assisted lipoplasty area. Additional lipoplasty areas are also marked (Figs. 24.7 – 24.10). All patients receive regional anesthesia with an epidural block for the surgical procedure; this prevents the need for lidocaine in the solutions which infiltrate the subcutaneous tissues in order to obtain tumescence, and permits the use of postoperative analgesia utilizing the epidural catheter during the hospital stay.

Management of intraoperative fluids begins preoperatively by administering an average of 1 l of isotonic saline solution (0.9 %) with 5 % glucose before arriving at the operating room. The purpose of this is to hydrate the patient, who has been fasting for 8 h. Prior to surgery, a urinary catheter is placed as an aid to intraoperative fluid management. The surgical procedure is always initiated in the posterior region with the patient in the prone position. The liposuction region is infil-

Figs. 24.7 – 24.10. Complete marking of a patient who underwent an extensive abdominoplasty and circumferential large volume lipoplasty

trated with a consistent solution of 1 l of normal saline with 1 mg of adrenaline. The quantity of infiltrated fluid is the amount necessary to produce tumescence of the subcutaneous tissues. Usually this quantity is more than expected to extract during the procedure when performing lipoplasty using tumescent technique. The posterior area is infiltrated completely prior to initiating the extraction of fat. Liposuction is carried out in the flanks, lumbar region, and lower subscapular regions as well as the trochanteric and inner thigh areas if necessary. Assisted lipoplasty with internal ultrasound is not used nor is external ultrasound, since studies have shown that there is no major benefit over pure tumescent lipoplasty [29, 30].

Lipoplasty is performed in a combined and simultaneous manner by two plastic surgeons, one opposite the other, but always under the direction of the primary surgeon. Mercedes, cobra or Illouz cannulas are used in lipoplasty, 3 – 5 mm in diameter. Lipoplasty is initiated in the deeper plane using larger cannulas in order to finish with thinner cannulas. A fan technique is employed at all times in order to insure a better homogeneous result and to prevent irregularities. The pinching maneuver and the observation of the thickness of the skin flap over the cannula indicate the point in which the lipoplasty should be terminated (Figs. 24.11 – 24.14). Two small drains are left in place through the intergluteal incisions, directed towards both sides of the liposuction, in order to facilitate the exit of the residual fluids resulting from tissue tumescence. The drains are left in place for 5 – 7 days to prevent the appearance of seromas.

After finishing the posterior lipoplasty, the patient is placed in the supine position in order to begin the anterior procedure. Lipoplasty is carried out on the residual areas corresponding to the space between the mid-clavicular and axillary lines. The technique used is similar to that described for the posterolateral region. Fat is not extracted in areas where an abdominoplasty will be performed. The type of incision used for an abdominoplasty will depend on the particular characteristics of each patient. We prefer to use the Grazer or Baroudi [6, 31] type of incision, but we consider that the type of incision does not modify the results of the procedure.

The abdominoplasty area is infiltrated with the same solution used for lipoplasty, but in lesser quanti-

Figs. 24.11 – 24.14. Determination of the regularity and thickness of the flap by means of the pinch test, and by observation of the cannula through the flap

Fig. 24.15. Central detachment of the abdominal flap as necessary to make the plications. The lateral portions are not detached, nor are they liposuctioned

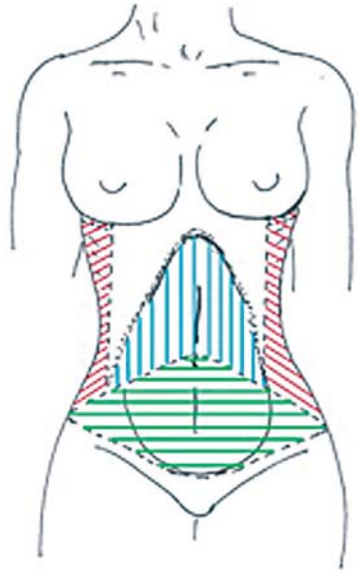


Fig. 24.16. Management of the anterior abdominal region. The region marked in *red,* which corresponds to the flanks, and which is situated between the midclavicular and the midaxillary lines, is treated with lipoplasty. The infra-abdominal area in *green* is the tissue to eliminate. The supraumbilical area in *blue* includes the extension of the detachment and lifting of the flap. The *white* area, included between the flanks in *red* and the area of detachment in *blue,* is not treated with detachment, or with lipoplasty. This is not done in order to preserve the vascularity of the flap

ties, only to obtain vasoconstriction. The detachment of the abdominal skin flap is carried out to the xyphoid process, but in the supraumbilical area only the necessary part is undermined in order to permit the placement of the abdominal rectus muscle plicatures (Fig. 24.15). This limited lateral undermining maintains maximal vascularity of the skin flap and prevents postoperative necrosis. This undermining also prevents communication between the area of the lipoplasty and the area of the abdominal skin flap. Different surgical techniques may be used on the anterior abdominal area (Fig. 24.16). A plication suture is placed on the abdominal rectus muscle fascia in a vertical fashion from the xyphoid process to the suprapubic region, using two planes of nonabsorbable sutures. Usually the umbilical scar is left free without fixing it to the rectus fascia. This is because the majority of our patients are overweight with a very thick skin flap, which makes it difficult to extract the umbilicus. On the other hand, if the patient is thin, fixation to the fascia is carried out. The patient is flexed, and the excess skin flap is eliminated. Negative suction drainage is left in the anterior area for approximately 5 days, being removed when the 24-h collection is less than 30 cc. The quantities removed are always quantified. In the case of lipoplasty, the total amount extracted is quantified, noting the difference between the supranatant and infranatant material. In the case of abdominoplasty, each extirpated flap is weighed individually.

For the intraoperative management of fluids, only crystalloids are used, proportionally approximately 300 cc for each liter of material extracted during lipoplasty. This amount is adjusted according to the particular characteristics of each patient, such as urine output, age, body mass, hematocrit, and the proportion of supernatant and infranatant obtained by liposuction. After surgery, the patient is wrapped with a soft compressive bandage with cotton. A girdle is not used in the immediate postoperative period, since it could roll up and compress in an irregular fashion, thus producing compromise of the skin flap. Also, due to the tumescent technique used, the girdle becomes abundantly wet, and would have to be changed very often, which may be painful.

24.5 Postoperative Management

The patient remains hospitalized on an average of 36–48 h. During this time crystalloids are administered on an average of 3,000 ml in 24 h. If a blood transfusion is needed it is given during the first 6 h postoperatively. Analgesics are administered through the epidural catheter, and bed stay is indicated for 24 h postoperatively. The intravenous fluids are discontinued when the patient is able to tolerate oral intake without problems while drinking abundant fluids. The drains are removed between 5 and 7 days postoperatively, depending on the residual outputs.

The postoperative girdle is indicated on the 5th day and has to be used most of the time for 6–8 weeks. Between the third and fifth postoperative day, therapeutic external ultrasound is begun, using 3 W cm^2. This

treatment is carried out every 3rd day for 3 weeks. Its principle objective is to improve postoperative edema and vascular congestion

Lastly, the patient is treated with subdermal therapy for 1 month using endermology, 50 min every 3rd day. This therapy has the objective of improving the subcutaneous scarring process and maximally preventing irregularities. During all this period, for the same reason, oral enzymatic anti-inflammatories are used.

24.6 Results (Patients 1 – 8, Figs. 24.17 – 24.24)

This surgical procedure has been performed on more than 200 patients during the past 6 years. In all these patients extraction by liposuction was more than 2,500 ml, and all cases were done in conjunction with abdominoplasty. The range of liposuctioned material, including infranatant and supranatant, was between 2,500 and 14,000 ml, with an average of 4,800 ml, while the range of the flap eliminated was between 380 and 5,100 g, with an average of 870 g.

Approximately 15 % of the patients were given autologous blood transfusions. The decline in hematocrit and hemoglobin, according to a pilot study, is an average of 9 % and 2.8 g respectively. The patients have shown an average weight reduction of 7 kg and up to six dress sizes, with a satisfaction index greater than 90 %. Several of our patients treated with this technique are presented.

24.7 Complications

The combination of an extensive abdominoplasty with large volume lipoplasty extraction should be considered as major surgery, with all of the implications therein. Therefore, it is not a surgery exempt of complications. These complications may be divided into minor and major. The complications may be due to errors in surgical technique, or complications inherent in the procedure. Complications such as seromas, palpable or visible irregularities, hyperpigmentation, asymmetry of scars, and overcorrection should be viewed as minor, but preventable. Cutaneous necrosis, infection, or fat embolism syndrome should be considered as major complications, and demand our maximum attention.

Fig. 24.17. Patient 1. **Top** Female, 24 years old. **Bottom** Four months postoperatively. Extraction of 3,600 cc through lipoplasty and 450 g through abdominoplasty. Mammary lift was also performed at the same surgery

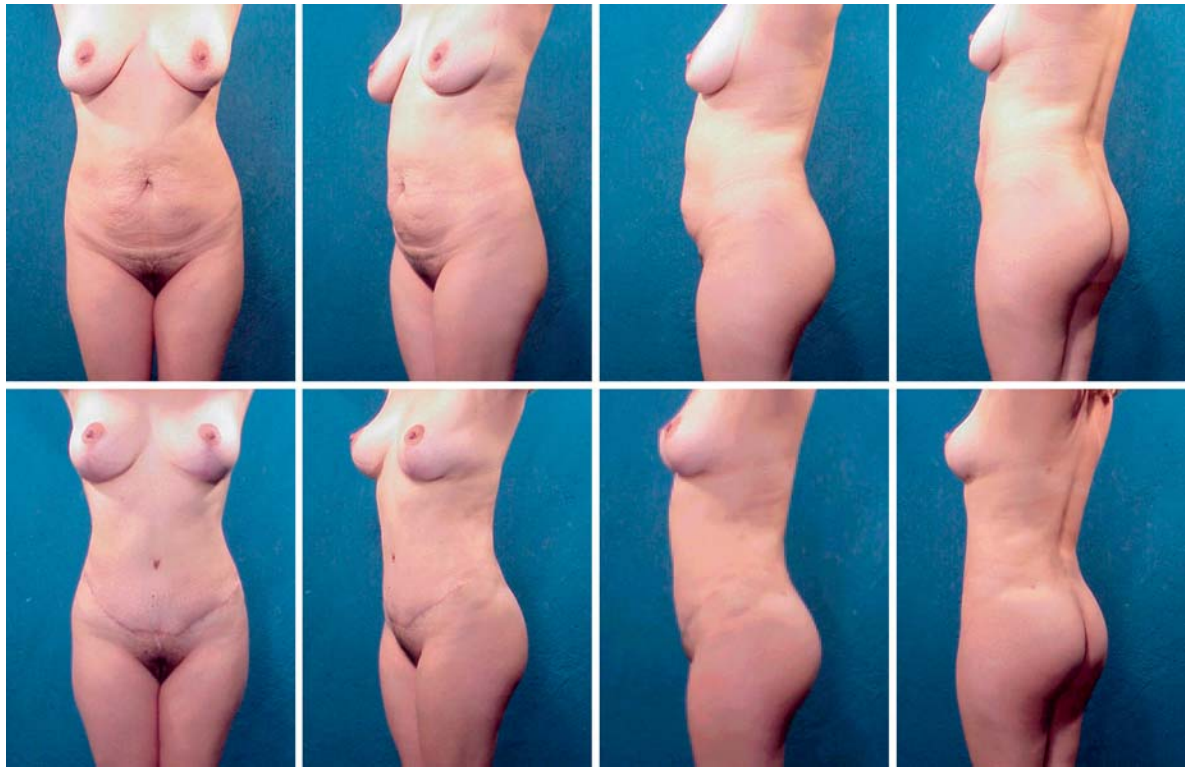


Fig. 24.18. Patient 2. **Top** Female, 31 years old. **Bottom** Eight months postoperatively. Extraction of 3,900 cc with lipoplasty, and 490 g with abdominoplasty. Mammary lift was also performed during the same surgery

Fig. 24.19. Patient 3. **Top** Female, 28 years old. **Bottom** Seven months postoperatively. Extraction of 4,500 cc with lipoplasty, and 550 g with abdominoplasty

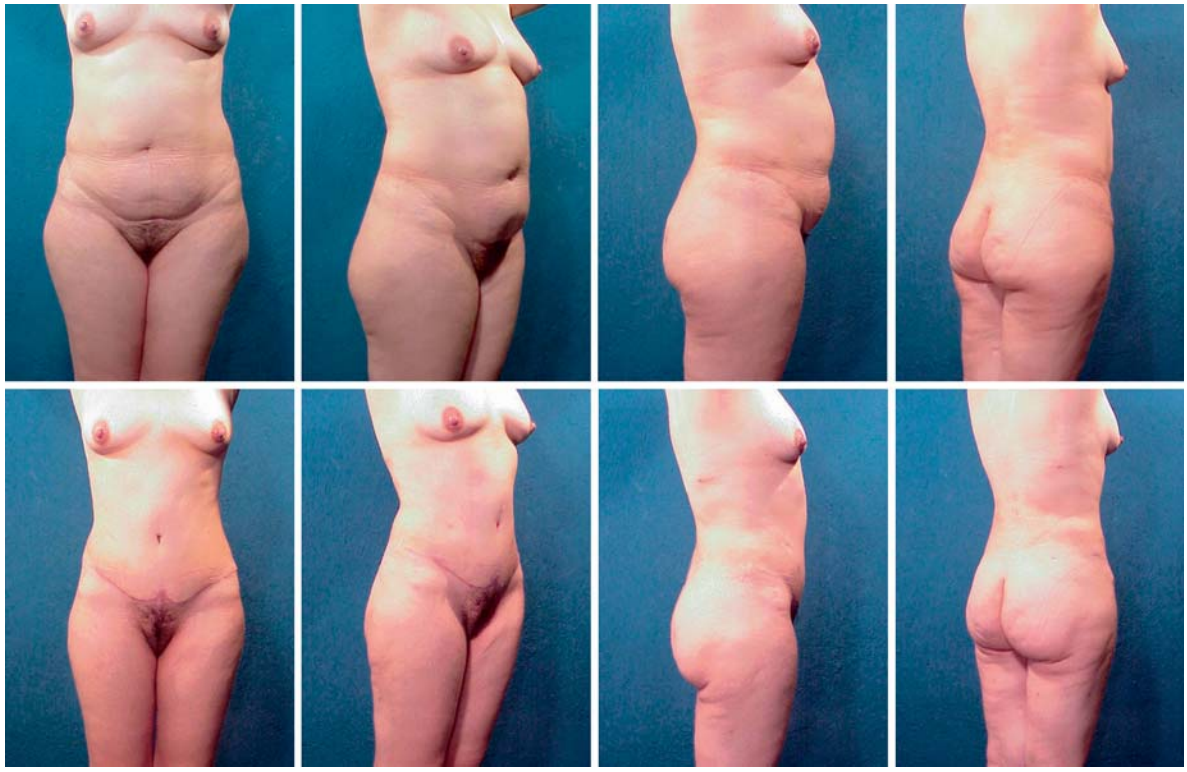


Fig. 24.20. Patient 4. **Top** Female, 34 years old. **Bottom** Two months postoperatively. Extraction of 6,100 cc with lipoplasty, and 850 g with abdominoplasty

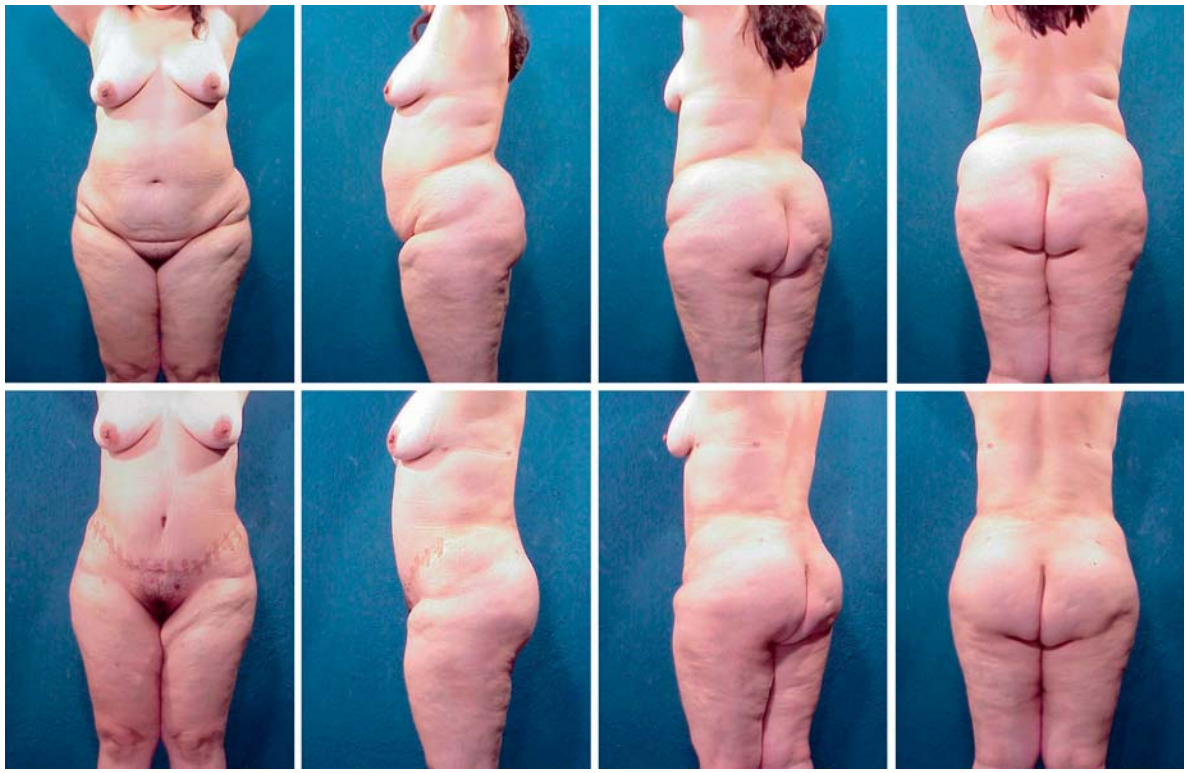


Fig. 24.21. Patient 5. **Top** Female, 32 years old. **Bottom** Two months postoperatively. Extraction of 7,300 cc with lipoplasty, and 1,200 g with abdominoplasty

Fig. 24.22. Patient 6. **Top** Female, 48 years old. **Bottom** Two years postoperatively. Extraction of 8,200 cc with lipoplasty, and 1,900 g with abdominoplasty

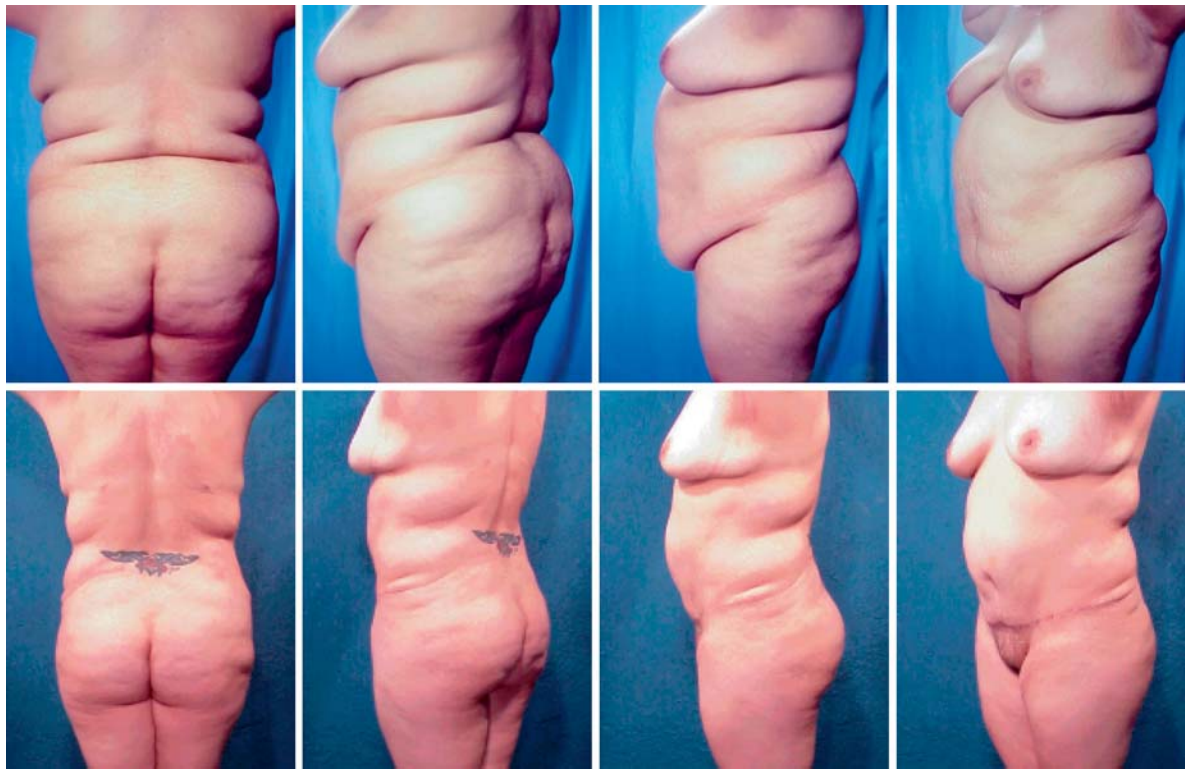


Fig. 24.23. Patient 7. **Top** Female, 44 years old. **Bottom** Three years postoperatively. Extraction of 9,400 cc with lipoplasty, and 2,900 g with abdominoplasty

Fig. 24.24. Patient 8. **Top** Female, 32 years old. **Bottom** Six months postoperatively. Extraction of 10,700 cc with lipoplasty, and 3,900 g with abdominoplasty

24.7.1 Seromas

This is one of the commonest complications. The accumulation of fluid may occur in the lipoplasty or abdominoplasty region. The frequency of seromas is high due to tumescence, which is used in lipoplasty. Fluid may pass to the area of abdominoplasty and can also accumulate in the anterior region. In order to prevent the formation of seromas, drains must always be used in the anterior as well as the posterior regions. A frequent error is to remove the drains early in the postoperative period, which almost always carries the risk of seroma formation. Because of this, the drains should not be removed until practically no fluid is draining through them, which usually occurs between the 5th and 7th postoperative day. Following this rule, we have maximally reduced this complication. The use of fixation sutures of the abdominal skin flap to the rectus muscle fascia helps to eliminate the formation of seromas in the abdominoplasty region. Additionally, it is very beneficial to use postoperative compression girdles. If a seroma appears, treatment consists of periodic drainage of the fluid and constant compression, or placing a drain and leaving it in place until fluid production is nil.

24.7.2 Irregularities

Irregularities appear primarily in the area of lipoplasty. Initially the irregularities are only palpable, but if more severe, may be visible, which may be more troublesome for the patient. The presence of irregularities is due to, among other things, errors of surgical technique in not leaving a homogeneous skin flap. This fault in homogeneity of the skin flap may be due to the excessive elimination of fat in some part of the operated area, or else not eliminating a sufficient amount in all areas of the skin flap. In order to prevent this complication one should follow certain delineations, such as using thin cannulas for regulating the skin flap, constant use of the pinching maneuver and visualization of the thickness of the skin flap to prevent overcorrection, and by using the fan technique to extract the fat. One should be prepared to infiltrate fat intraoperatively in case of excessive elimination of one area.

These precautions importantly diminish the development of irregularities, but it should be known that subcutaneous scar formation could also lead to irregularities. This problem is more frequent in those patients in whom there exists marked lipodystrophy and flaccidity, since subcutaneous retraction is more probable

in an irregular form. We have significantly diminished the appearance of this complication by employing ultrasound with subdermal endermologic therapy in the postoperative period.

24.7.3 Scar Hyperpigmentation

Scar hyperpigmentation following abdominoplasty is secondary to the personal factors of each patient. Nevertheless, scar hyperpigmentation following lipoplasty is often due to friction burns secondary to the surgical procedure. Employing two maneuvers may prevent scar hyperpigmentation: (1) protection of the wound by isolating the skin from the cannula by additional skin protectors, or (2) by enlarging the wound slightly so that the rubbing is not as severe. We prefer the second method, since the use of skin protectors is found to be somewhat uncomfortable during the surgical procedure.

24.7.4 Scar Asymmetry

This problem occurs principally in the abdominoplasty scar. It appeared in our first patients and was felt to be due to the lack of experience in the cutaneous retraction produced following extensive lipoplasty. Cutting the abdominal flap should always be based on exact previously determined measurement prior to initiating abdominoplasty. After lipoplasty of the flanks and anterior abdomen, the liposuctioned area and the flexion of the patient can distort the cut area of the abdominoplasty. This distortion suggests that the cut should be made over the crease that is produced by lipoplasty, since it appears that by not doing it this way will leave quite a bit of flaccidity in the lateral portions of the abdominoplasty. Nevertheless, the cutaneous retraction is so good that following the cut just as planned does not leave residual flaccidity, while making the cut over the creases that appear following lipoplasty will always produce scar asymmetry.

24.7.5 Overcorrection

This problem is caused by a poor surgical technique, with an incorrect appreciation of how the aesthetic contour should be. The cause is due to an excessive elimination of fat. This complication is more noted where there exists a transition between the treated area by lipoplasty and the area not treated, which may be noted by a depression or step. In order to prevent this, very thin cannulas should also be used in the transition area of lipoplasty. In case an overcorrection occurs, and is noted intraoperatively, fat infiltration resolves the problem efficaciously.

24.7.6 Infection

While leaving drains in place longer than usual helps to prevent seromas, it may produce ascending contamination. Infection is a very rare complication if aseptic standards are followed during the surgical procedure. Nevertheless, if special postoperative care of the drains is not observed, infection may occur. This is more common in the posterior drains near the anal region. Because of this, the patient should be informed about the presence of drains, and about how to preserve hygiene. In case an infection is noted after the 7th postoperative day, one should think about an ascending contamination through the drains with coliform microorganisms. Microbiological confirmation with a culture and sensitivity will guide treatment, usually with excellent results.

24.7.7 Cutaneous Necrosis

Cutaneous necrosis following this type of surgery may follow either lipoplasty or abdominoplasty. The principal cause of necrosis in the lipoplasty area is generally due to inadequate management of the tissues during surgery. This mismanagement consists of applying excessive pressure or pinching the flap against the cannula during lipoplasty, or the excessive traumatization of the skin with the tip of the cannula. This damage with the cannula tip is more common above all at the level of the flanks, since this area is where lipoplasty is performed in an oblique manner and not parallel to the skin as in the rest of the surgery. In order to prevent this complication, the tissues should be handled appropriately, and by careful observation of the noted concepts already mentioned.

Fortunately, the areas of necrosis following lipoplasty are small and superficial, and tend to resolve by secondary reepithelization. Necrosis that presents in the area of abdominoplasty is due generally to poor vascularity of the edge of the flap. This may be due to predisposing preoperative factors, such as cigarette smoking, or transverse abdominal scars, but the most frequent cause is damage to the vascular plexus of the flap during surgery.

In our series, we have had only one case of partial necrosis of the abdominal flap caused by liposuctioning the flap at the same time. For this reason we do not recommend liposuctioning the detached area, even though the patient requires this maneuver. In these cases the patient is advised that it is probable that it will be necessary to perform lipoplasty of that area with later surgery. Similarly, lipectomy of the distal border of the flap is not usually done, the flap is handled in a gentle manner, and we always limit the detachment of the

superior aspect of the abdominoplasty to that necessary for the placement of plication sutures of the rectus muscles. A less common cause of cutaneous necrosis is a very tight bandage or one that has rolled up in the immediate postoperative period, which therefore requires special caution in its use. With these guidelines, the appearance of necrosis should not be a problem in this type of surgery.

24.7.8 Fat Embolism Syndrome

This is a serious complication, but fortunately very infrequent, which carries a good prognosis if treated in a timely manner. We have had only one case in more than 6 years using this technique. Suspicion should be raised when the patient presents blood pressure alterations without apparent cause generally 24 h postoperatively. The diagnosis is principally clinical and treatment should be undertaken in the intensive care unit in order to maximally diminish mortality. The cause of fat embolism is due to the introduction of particles of fat into the circulatory system, with the resulting alterations that accompany this syndrome. Nonetheless, in spite of numerous theories and studies about its etiologic pathogenesis, total prevention is not yet possible, and therefore general existing measures need to be followed to prevent its occurrence. Keeping in mind that its prevention is difficult, one should always be alert to the appearance of fat embolism, in order to treat it adequately.

24.8 Conclusions

The combination of large volume lipoplasty with abdominoplasty should be a safe surgical procedure. One should take all the details into account when performing this type of surgery. With the passage of time, our procedure has been modified, and this has enabled us to offer more satisfactory and safer results for patients. The teaching learning curve fulfills a very important role in this type of surgery, since it not a very common combination in plastic surgery. Therefore, experienced surgeons in both procedures should perform this surgery in order to achieve good results. It is a procedure that, if performed in an adequate manner, provides very satisfactory results. The basic factors in order to maximally minimize risks and improve outcomes should be taken into account. It is essential to use the tumescent technique for lipoplasty. Do not use lidocaine in the infiltrating solutions in order to prevent lidocaine toxicity. The use of cannulas smaller than 5 mm greatly improves the aesthetic results. Gentle manipulation of the tissues prevents cutaneous compromise. Not liposuctioning the flap prevents necrosis of the flap. Above all, this procedure should not be used as a means to lose weight, but as a surgical procedure, which improves the body contour in patients with differing degrees of obesity. Always following these guidelines gives us the best results not only for our patients, but also for us.

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Prevention and Treatment of Liposuction Complications

25

Melvin A. Shiffman

25.1 Introduction

Liposuction of the abdomen may be associated with a variety of complications most of which can be avoided. The more aggressive the liposuction, especially in the superficial subcutaneous tissues and with large amounts of fat removal, the more likely a complication will occur. "It is not so much what is removed that is important, but what is left behind" [1].

25.2 Complications

25.2.1 Asymmetry

If the patient has asymmetry of the abdominal wall preoperatively, this should be pointed out to the patient and recorded with adequate photos. More fat may have to be removed from one side or one area of the abdominal wall because of the asymmetric accumulation. Asymmetry can be avoided by being aware of the amounts of fat and fluid removed from each side of the abdomen so that there is no large discrepancy. Observing the results carefully at the end of liposuction may disclose further areas that need correction.

Asymmetry that is present postoperatively may need revision liposuction for removal of excess fat from those areas affected. If there is a deficit in any area that needs correction, injection of autologous fat may be considered.

25.2.2 Depressions (Grooves, Waviness)

Excessive or superficial liposuction too close to the skin may result in depressions. Superficial liposuction should not get closer than 1 cm below the skin of the abdominal wall, and smaller cannulas (< 3.5 mm) should be utilized in comparison to the deep liposuction that can be performed with cannulas over 3.5 mm (3.5 – 6.0 mm depending on the thickness of the fat layer).

Depressions can be corrected by selectively liposuctioning the areas around the depression and filling the indented area with autologous fat [2]. If the indentation is noted while performing the liposuction, autologous fat can be injected at that time. It is possible to fill defects with the "liposhifting" technique by tumescing the areas around the depression, loosening the fat with multiple criss-crossing tunnels, and molding the fat into the defect by rolling a large cannula (6 – 10 mm) across the prepared areas toward the depression [3].

The skin scar may become depressed and is usually due to the suction staying on when the cannula is removed and reinserted multiple times. This can be prevented by turning off the suction before removing the cannula or by having a finger vent in the handle of the cannula.

25.2.3 Chronic Edema

An infrequent occurrence, persistent edema in the area of liposuction, can be distressing to the patient. This may be due to excessive trauma to the tissues but liposuction is a traumatic procedure causing so-called "internal burn-like injury." Proper compression is usually the key to prevention. Remember that excessive compression of an extremity can result in venous thrombosis and possible embolic disorder.

Repeat liposuction (in an amount to break up the edematous tissues and flatten the region) of the area with tumescent technique is usually helpful but must be followed by adequate compression dressings.

25.2.4 Bleeding, Hematoma

Tumescent technique in liposuction has reduced the amount of bleeding to a degree that is usually minimal. Preoperatively, the patient must be forewarned to stop all aspirin containing products, ibuprofen, and herbs at least 2 weeks before and for 2 weeks after surgery. Excessive liposuctioning in a single area may cause bloody fluid to appear in the tubing and this should forewarn the surgeon not to continue surgery in that

area unless further tumescent solution is used. The use of low vacuum pressures (250 – 300 mm) on the liposuction machine or venting the liposuction syringe will reduce bleeding.

Bleeding following liposuction may appear as bright red blood coming from the incision site or may be hidden and appear as orthostatic hypotension when the patient tries to sit up or stand. Postoperative dizziness and feeling faint should not be considered a drug reaction or dehydration until after the Hgb or Hct is checked. Intravenous fluid resuscitation may be enough if the bleeding is not over 15% of the blood volume but some patients with more blood loss may require Hespan, dextran, albumin, or blood to restore the blood volume.

Hematoma in the tissues can be treated conservatively with aspiration. This should be distinguished from bruising that requires no treatment. A hematoma that becomes a persistent untreated mass will form a seroma and then a chronic pseudocyst.

25.2.5 Seroma

The collection of serous fluid in the liposuction area may be due to irritation of the tissues by the traumatic procedure but is more frequently the result of concomitant oversuctioning of a single area with undermining of a flap allowing a cavity to form. Sometimes a hematoma may appear first and be replaced over time with serosanguineous fluid and then serous fluid.

A persistent collection of fluid following liposuction may be treated with needle aspiration followed by adequate compression dressings. This may need to be repeated every few days. If the collection can be reached through one of the liposuction incisions, a drain can be inserted to reduce the fluid and kept in place with compression dressings that need to be changed every couple of days. Prophylactic antibiotics may be used during the time the drain is in place. If the collection becomes chronic (over 4 weeks), the fluid should be aspirated and air may be injected into the cavity to cause irritation (Fig. 25.1). Compression dressings are necessary after each such treatment. Another method that is available but requires adequate anesthesia is curetting the lining of the cavity through a small incision or through one of the liposuction incisions. If the liposuction is combined with abdominoplasty and a chronic seroma occurs, the pseudocyst may be excised through the abdominal scar (Fig. 25.2).

25.2.6 Infection

The occurrence of infection in a clean surgery case is approximately 1% in outpatient surgery and 3% in hospital surgery. The tendency to consider liposuction as minor surgery with minimal care about sterility in the surgery suite can be detrimental to the patient. Serious infections have been documented following liposuction [4, 5]. Necrotizing fasciitis [6, 7] and toxic shock syndrome [8, 9] have been reported.

Postsurgical infection should be diagnosed as early as possible in order to prevent more serious manifestations of the infection such as necrosis, septicemia, or toxic shock. Blisters may presage the appearance of necrosis and should be treated and observed closely. There are various dressings that may cause blisters such as tape on the skin and Reston foam. Any erythema is an indication of inflammation or infection and should be treated as such with antibiotics and close follow-up.

25.2.7 Perforation of Intra-abdominal Vessel or Viscus [10 – 12]

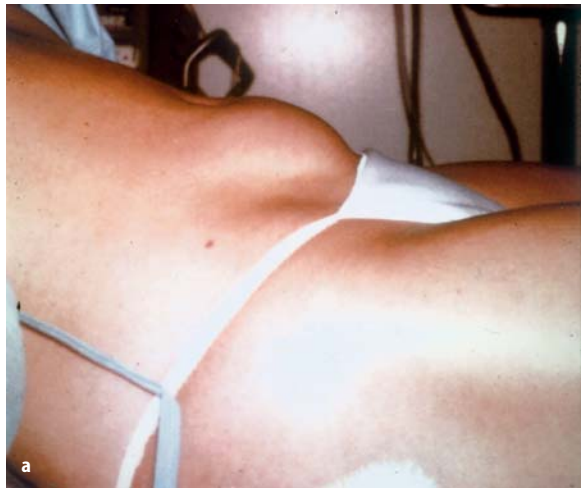
Perforation of the abdominal wall is most likely to occur in the presence of hernia or abdominal wall scar, which can divert the direction of the cannula. The nondominant hand should always feel the end of the cannula. When the cannula is not palpable, the surgeon should reassess his technique and consider perforation of the abdominal wall. Under local tumescent anesthesia, perforation can be detected at the time of surgery by the presence of abdominal pain. Liposuction over the ribs can be aided by the use of pressure on the lower ribs with the flat portion of the non-dominant hand, which will result in the cannula easily going over the ribs instead of under with perforation into the chest.

If there is unusual abdominal pain postoperatively such as increasing pain or severe pain, perforation must be considered. It may be difficult to examine the abdomen directly by pressure because liposuction alone will cause pain in the area. The presence of rebound tenderness usually indicates peritonitis. Flat plate and upright abdominal X-rays may show free air if the bowel is perforated. The patient may have to be observed in the hospital if there is the possibility of viscus perforation. Vascular perforation that causes significant blood loss will result in abdominal pain, orthostatic hypotension, and shock. Insertion of a small catheter (Angiocath) into the abdominal cavity and the instillation of some sterile saline can produce bloody drainage consistent with vascular injury. If the blood is totally retroperitoneal, CT scan may be necessary. Emergency exploratory laparotomy is usually indicated.

25.2.8 Thromboembolism [10]

Medium- and high-risk patients for thromboembolism should have the necessary precautions taken in the perioperative period (see Chapter 27). These include

Fig. 25.1. a *Left* Preoperative 43-year-old female with history of liposuction of inner and outer thighs 6 years previously. *Right* one week postoperatively with swelling of thighs **b** Five months postoperatively with chronic seromas outlined following multiple needle aspirations and compression as well as open drainage with a drain. **c** Ultrasound of seroma in right thigh at 5 months postoperatively (*arrow* seroma). **d** Ultrasound of right thigh seroma 6 ½ months postoperatively following one injection of room air into the seroma (*arrow* seroma). This shows a marked decrease in the size of the cavity. The left thigh was injected once with room air and had complete closure of the seroma



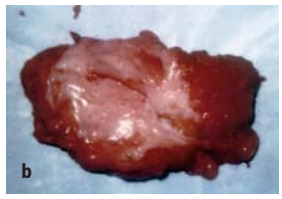


Fig. 25.2. a Postoperative liposuction and mini-abdominoplasty with bulging chronic seroma (pseudocyst) 3 months postoperatively. **b** Pseudocyst following excision

compression stockings (TEDS) or intermittent compression garments. Failure to warn female patients to stop estrogens at least 2 weeks prior to surgery may increase the risk of thromboembolism [13].

Thromboembolism has to be diagnosed early if death is to be prevented. Any postoperative patient who develops shortness of breath or chest pain must be considered to have possible pulmonary embolism and a ventilation-perfusion lung scan obtained. The use of intravenous heparin can be life-saving and, at times, may be started even before the confirmed diagnosis.

25.2.9 Scars

Significant scars following liposuction are not frequent. It is rare to see hypertrophic scars or keloids. Poor placement of incisions may result in easily visible scars. Some scars may become depressed if the suction on the cannula is maintained each time the cannula is withdrawn from the incision. If using a machine for vacuum, either stop the machine before withdrawal or use cannulas with a hole vent in the thumb portion of the handle for easy release.

Incision sites may be irritated by the multiple fast passes of the cannula, resulting in a reddening around or in the scar. Steroid creams will resolve the problem. The incision performed should always be slightly larger than the cannula. Some surgeons use a plastic plug in the incision while performing liposuction that will prevent the cannula from rubbing on the skin.

The use of large incisions is not indicated since most cannulas are 6 mm or less and more often than not are 4 mm or less. Some surgeons use microcannulas (under 2 mm), but this requires many more skin incisions and the liposuction takes longer to perform.

The treatment of hypertrophic or keloid scars includes steroid injection, radiation, reexcision, silicone gel sheeting, pressure therapy, or a combination of these [14]. None of the treatments is effective in a large percentage of patients; however, hypertrophic scars have a tendency to resolve on their own over a period of time.

Skin necrosis will usually result in a significant scar. Treatment may require excision and careful closure.

25.2.10 Neurologic Problems

Decreased sensation or sensory loss may occur but is almost always temporary.

Chronic pain may be due to a small neuroma but is more often due to injury to the underlying fascia or muscle. Injection of local anesthetic into the area of pain will usually relieve the complaint for a short period of time. Multiple injections may be necessary to relieve the pain permanently. A neuroma can be surgically resected. If a scar in the tissues (subcutaneous fat, fascia, or muscle) is tethered to the skin, there may be chronic unrelieved pain. The pain may have to be treated by release of the scar.

25.2.11 Lidocaine Toxicity

There is very little treatment for lidocaine toxicity except for supportive methods. This problem can easily be avoided by keeping the lidocaine at a safe level through the use of less than 35 mg/kg or, when absolutely necessary, a maximum of 55 mg/kg in the total tumescent fluid. However, "just because a surgeon has infiltrated, without mishap, 50–60 mg/kg lidocaine in hundreds of cases does not necessarily imply either that such a large dose of lidocaine can be given with impunity, or that this dose recommendation is 'safe'" [15]. If general anesthesia is used, the lidocaine total can be much less.

A careful history must be taken to make sure the patient has not been taking cytochrome P450 inhibitors, which may result in lidocaine toxicity even with the total lidocaine dosage within the usually accepted maximum [16]. Lidocaine occurs in the body as unbound pharmacologically active lidocaine and protein bound inactive lidocaine. Factors affecting the protein binding of lidocaine include age, stress, obesity, hepatic function, renal function, cardiac disease, cigarette smoking, use of oral contraceptives, beta blockers, tricyclic de-

pressants, histamine-2-blockers, inhalation anesthetics, and anorexants [17]. The injection of lidocaine in small amounts as a local anesthetic has been associated with death from allergic reaction to the preservative, methylparaben.

25.2.12 Necrosis

There may be skin necrosis after liposuction if the cannula comes too close to the skin and disrupts the subdermal plexus of vessels (Fig. 25.3). This is more likely to occur with the use of cannulas with sharp edges and turning the openings toward the skin surface. Combining excessive liposuction of the mid upper abdomen and full abdominoplasty increases the risk of necrosis of the abdominoplasty flap.

Necrotizing fasciitis has been reported following liposuction [18]. This disorder is a fulminant streptococcal group A infection or mixed bacterial infection frequently with anaerobes that involves the superficial and deep fascia, producing thrombosis of the subcutaneous vessels and gangrene of the underlying tissues. Treatment requires surgical debridement, antibiotics, and hyperbaric therapy [19].

25.2.13 Toxic Shock Syndrome

There have been reports of toxic shock syndrome, which is a potentially fatal disorder [20, 21]. The syndrome is caused by the exotoxins (superantigens) secreted with infection from *Staphylococcus aureus* and group A streptococci [22]. Knowledge of the criteria for diagnosis is important in order to treat this potentially fatal disease. These include [22]:

1. Fever (>102°)
2. Rash (diffuse, macular erythroderma)
3. Desquamation (1–2 weeks after onset, especially of palms and sole)
4. Hypotension
5. Involvement of three or more organ systems:
   a) Gastrointestinal (vomiting, diarrhea at onset)
   b) Muscular (myalgia, elevated CPK)
   c) Mucous membrane (conjunctiva, oropharynx)
   d) Renal (BUN or creatinine >2 times normal)
   e) Hepatic (bilirubin, SGOT, SGPT >2 times normal)
   f) Hematologic (platelets <100,000)
6. Negative results on the following studies (if obtained)
   a) Blood, throat or cerebral spinal fluid (CSF) cultures
   b) Serologic tests for Rocky Mountain spotted fever, leptospirosis, measles

Treatment consists of surgical debridement for necrosis, antibiotics, circulatory and respiratory care, anticoagulant therapy for disseminated intravascular coagulation, and immunoglobulin [23]. Experimental approaches have included use of anti-tumor necrosis factor monoclonal antibodies and plasmapheresis.

25.3 Conclusions

Complications of liposuction are best avoided when possible. The surgeon should be aware of the available treatments for the various complications. It is preferable not to combine large abdominal liposuction with concomitant abdominoplasty since this will increase the possibility of a variety of complications.

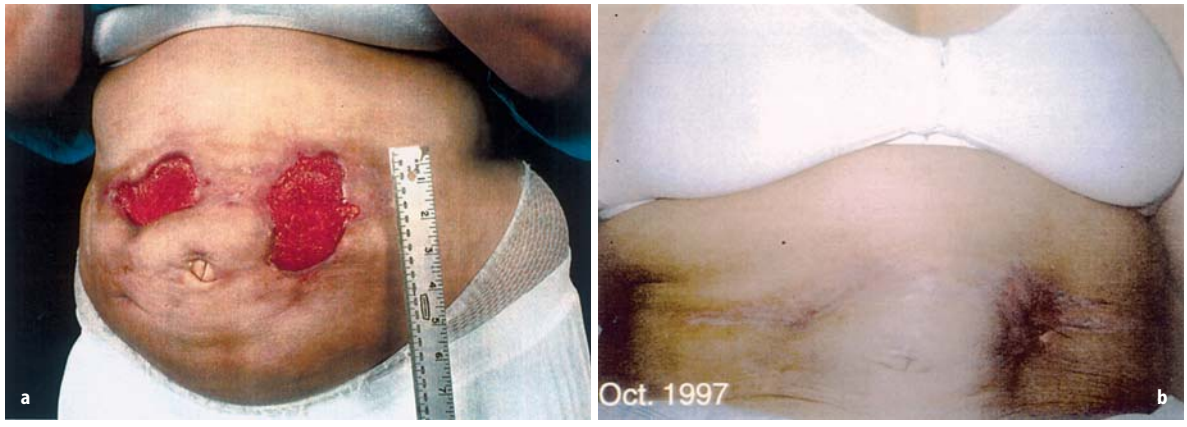


Fig. 25.3. a Extensive necrosis of the upper abdominal wall following liposuction. **b** Indented scarring of the upper abdominal wall following complete healing by secondary intention

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Guidelines for the Prevention of Thromboembolism

26

Melvin A. Shiffman

26.1 Introduction

Patients who undergo surgery are at risk from venous thromboembolic complications. This is especially critical in the abdominoplasty or liposuction patient who, having an elective procedure, would not expect to have the morbidity or mortality associated with thromboembolic disease. The cosmetic surgeon must be aware of the possibility of thromboembolism in every patient and should take a careful history to disclose predisposing risk factors. The surgeon should also be aware of the clinical manifestations of pulmonary embolus in order to make a timely diagnosis.

26.2 Risk Factors

Minor surgery < 30 min in patients over 40 years of age without additional risk factors and uncomplicated surgery in patients less than 40 years of age without additional risk factors are in the low risk category. General surgery in patients over 40 years of age lasting > 30 min and patients under 40 years on oral contraceptives are in the moderate risk category [1]. High risk category would be major surgery in patients over 40 years of age with recent history of deep vein thrombosis or pulmonary embolism, extensive pelvic or abdominal surgery for malignancy, and major orthopedic surgery of the lower extremities.

Predisposing risk factors include age over 40 years, malignancy, obesity, prior history of thromboembolism, varicose veins, recent operative procedures, and thrombophilia. These risks are further modified by duration and type of anesthesia, preoperative and postoperative immobilization, level of hydration, and the presence of sepsis [2]. Medical problems associated with increased risk include acute myocardial infarction, stroke, and immobilization [3]. Estrogen therapy and pregnancy are common risk factors while uncommon factors include lupus anticoagulant, nephrotic syndrome, inflammatory bowel disease, polycythemia vera, persistent thrombocytosis, paroxysmal nocturnal hemoglobinuria, and inherited factors such as antithrombin III deficiency, protein C deficiency, protein S deficiency, plasminogen activator deficiency, elevated plasminogen activator inhibitor, and homocystinuria [4].

Table 26.1. Risk categories and associated thromboembolism

Risk	Calf vein thrombosis	Proximal vein thrombosis	Fatal pulmonary embolism
Low	< – 10 %	< – 1 %	< – 0.01 %
Moderate	10 % – 40 %	2 % – 10 %	0.1 % – 0.7 %
High	40 % – 80 %	10 % – 30 %	1 % – 5 %

Superficial calf vein thrombosis, proximal deep vein thrombosis, and fatal pulmonary embolus increase in incidence as the risk category increases from low to high (Table 26.1).

26.3 Clinical Manifestations

Superficial thrombophlebitis (an inflamed vein) appears as a red, tender cord. Deep-vein thrombosis may be associated with pain at rest or only during exercise with edema distal to the obstructed vein. The first manifestation can be pulmonary embolism. There may be tenderness in the extremity and the temperature of the skin may be increased. Increased resistance or pain on voluntary dorsiflexion of the foot (Homan's sign) and/or tenderness of the calf on palpation are useful diagnostic criteria.

Pulmonary embolism is usually manifested by one of three clinical patterns: (1) onset of sudden dyspnea with tachypnea and no other symptoms; (2) sudden pleuritic chest pain and dyspnea associated with findings of pleural effusion or lung consolidation; and (3) sudden apprehension, chest discomfort, and dyspnea with findings of cor pulmonale and systemic hypotension. The symptoms occasionally consist of fever, arrhythmias, or refractory congestive heart failure.

26.4 Diagnosis

Deep-vein thrombosis is best diagnosed with duplex ultrasonography, which combines pulsed gated Doppler evaluation of blood flow with real-time ultrasound imaging. Other diagnostic tests include X-ray venography, radionuclide venography, radioisotope-labeled fibrinogen, ultrasonography, and impedance plethysmography. Liquid crystal thermography detects increases in skin temperature and is a useful adjunct to ultrasonography or impedance plethysmography.

Ventilation-perfusion (VP scan) lung scan is a safe, sensitive means of diagnosing pulmonary embolism. Isotope pulmonary perfusion scan (Q scan) is more specific with inclusion of the isotope ventilation scan (V scan). The definitive diagnosis can be made by pulmonary arteriography but VP scan can give a high degree of certainty. Arterial blood gas typically shows reduction in PaO_2 and $PaCO_2$ while the electrocardiogram will show tachycardia but is best used for ruling out myocardial infarction. Chest X-ray may show basilar atelectasis, infiltrates, pleural effusion, or cardiac dilatation.

26.5 Prophylactic Treatment

Low risk general surgical patients may be treated with graduated compression stockings applied during surgery, early ambulation, and adequate hydration [5]. Keeping the knees flexed on pillows during surgery and avoiding local compression on any areas of the legs are helpful. All patients are treated the same if there are any low risk factors. The type of surgery does not matter as long as general anesthesia or intravenous sedation is given. Compression stockings (20 – 30 mm support hose is adequate) are applied in the operating room and ambulation is begun when the patient is awake and capable of ambulating with assistance. When the patient is ambulating on a regular basis during the day, the compression stockings can be removed.

For moderate risk patients, low-dose heparin (5,000 units 2 h before surgery and then every 8 – 12 h until ambulatory), low molecular weight heparin (LMWH), dextran, or aspirin is recommended. Alternatively, graduated compression stockings or intermittent pneumatic compression started at the onset of surgery, used continuously until ambulatory, or a combination of both is recommended [2]. Intermittent compression garments are better protection than the graduated compression stockings.

All high-risk patients should be treated with low-dose heparin or LMWH, and combined pharmacologic and mechanical methods.

Dextran can result in cardiac overload, and high dose aspirin (1,000 – 1,500 mg/day) has limited efficacy in preventing deep-vein thrombosis. In cosmetic surgery, use of aspirin or heparin may result in postoperative bleeding

26.6 Discussion

The best prophylaxis for low risk cosmetic surgery patients would appear to be mechanical methods including knee compression stockings and early ambulation. For low risk patients the knees should be slightly flexed and extremity compression avoided [6].

The risk of thromboembolism increases when liposuction is combined with abdominoplasty. This should be taken into consideration when planning therapy for abdominal lipodystrophy and abdominal wall dermatochalasis. Estrogen, as birth control pills and replacement therapy, increase the risk of thromboembolism and should be avoided from 3 weeks before surgery until 2 weeks after surgery. Precautions should be taken during surgery when the procedure has moderate risk for thromboembolism.

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Medical Legal Aspects of Aesthetic Surgery of the Abdominal Wall

27

Melvin A. Shiffman

27.1 Introduction

The medical legal consequences of complications, mistakes in judgment, and failure to timely diagnose and treat the patient can result in prolonged litigation, loss of time from work and income, and have a toll on the emotional health of the physician. If there is a large settlement or judgment, the report that is forwarded to the National Data Bank may have prolonged consequences that may make applying to hospitals for privileges or obtaining malpractice coverage difficult.

It behooves the surgeon to be aware of the areas of conduct that can result in malpractice litigation. The surgeon should be cognizant of the local, state, and federal laws that may apply to the practice of medicine as well as the laws derived from prior medical legal cases.

27.2 Negligence

Negligence requires that there be a duty to the patient. This may be the physician or any healthcare personnel. There must be a breach of that duty and the breach must cause damages (causation). If any of these conditions are not proven, then there is no negligence.

27.3 Standard of Care

The legal definition of Standard of Care is what a reasonably prudent (careful) physician would do under the same or similar circumstances in the same locality. Locality now refers mainly to national standards because there are national examinations, national meetings, and medical journals and texts contain authors from all over the country. What a reasonably prudent physician would do is determined by the testimony of experts. An attorney can usually find an "expert" who will testify against another physician. Standard of Care not only refers to specific decisions in treatment but also in delays in diagnosis and treatment, medical record problems, and errors in surgical techniques.

27.4 Informed Consent

The concept of Informed Consent is a legal term that is now used in medical care.

To sign a consent form for surgery in the hospital that states, "I have been informed of the risks and complications of the procedure", is not an informed consent. To obtain a legal Informed Consent the patient must be fully knowledgeable about the procedure, alternatives, and possible complications. The surgeon or his representative must discuss the surgical procedure being proposed, its material risks and complications, all viable alternatives and their risks and complications, and answer all questions. If a representative discusses these things, the surgeon still must answer all remaining patient questions concerning the procedure and its risks. The "materiality" of any risks is only decided at trial and can be, depending on the jurisdiction, material to a reasonable patient (a jury decision), the specific patient, or a reasonable physician. Alternatives must be "viable" in that these courses of treatment have to be applicable to the patient's problem(s).

In planning to perform liposuction of the abdomen, there should at least be a discussion of the possibility of abdominoplasty before or after the procedure and vice versa. A discussion on weight loss methods prior to any surgical procedure may be indicated.

The theoretical effect of a patient initialing each paragraph in a list of possible risks and complications is mitigated by the fact that most patients, at the time of litigation, will state that the paragraphs were initialed but not read. There is also the problem of cognitive dysfunction following surgery that may be the source of the patient's inability to recall the information initialed [1]. One way to prevent the patient from claiming that the informed consent document was not read and understood is to have the following statement signed by a witness in the office:

I requested that the patient read the complete document. I observed the patient read the document and the patient stated that the document was completely read and, after questions were answered, that the complete document was understood.

Witness: _____ **Date:** _____

In order to establish the fact that the patient has made a knowledgeable decision about the contemplated procedure through a discussion with the surgeon, a statement should be recorded in the medical record. The following statement signed by the surgeon, in the author's opinion, will usually suffice to establish informed consent:

The surgical procedure was discussed with the patient including its material risks and complications, viable alternatives and their material risks and complications, and all questions were answered.

27.5 Legal Cases

Sometimes the best way to learn about how to prevent litigation is to read the legal cases and analyze the possible mistakes that were made and how to prevent them. Even though the results of a case may have been for the defendant physician, there is usually a reason that litigation was started. Sometimes, it is only an angry patient trying to get even or lack of attention of the surgeon to the requests or demands of the patient but too often it is from failure to adequately care for the patient's medical needs.

The following cases include some that were a result of State Medical Board Accusations. Medical Board litigation can be devastating to the physician's career with a potential of loss of license and at least a very costly defense.

27.6 Liposuction

27.6.1
Estate of Marinelli v Geffner, Ocean County (NJ), Superior Court. In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(10):54 – 55

The 23-year-old plaintiff's decedent had liposuction of her legs. Postoperatively she died from multiple pulmonary emboli. The plaintiff alleged that the bandage on the leg was too tight causing the blood clot and that the defendant failed to advise the patient to discontinue her birth control pills. At trial it was shown that the defendant had no experience with liposuction other than attending a three-hour seminar and he did not have the appropriate understanding of the anatomy of the leg. There was a $558,600 verdict.

Comment: It is routine for surgeons performing cosmetic surgery to recommend stopping estrogen at least 2 weeks prior to and following surgery. Since estrogens are a known cause of thromboembolus, being off estrogens at the time of surgery will decrease the risk. It should be obvious that dressings to extremities should not be tight enough to obstruct the vascular flow. There are garments available that compress without this problem.

27.6.2
Herron v Stewart, Forsyth County (NC) Superior Court

The 37-year-old plaintiff's decedent was having liposuction surgery of the lower eyelids in December 1990 when she developed cardiovascular collapse a few minutes after administration of local anesthesia. She was revived after 40 – 50 min but suffered severe brain damage. The decedent lived in a vegetative state until she died 2 years later. The plaintiff alleged failure to diagnose the collapse and to respond quickly in that they waited to call for emergency help and did not follow proper medical procedures. The defendants claimed that they did all that they could to save the decedent's life and that the decedent had been anesthetized with the same drugs at least twice before without any complications. There was a confidential settlement after the jury returned deadlocked in June 1995.

Comment: Every surgeon should be prepared for any emergency such as cardiovascular collapse and respond promptly with the proper medications. Paramedics should be summoned immediately. Local anesthesia containing methylparaben as a preservative given even in small amounts has the danger of causing an acute anaphylactic reaction.

27.6.3
Taylor v Graves, San Diego County (CA) Superior Court, Case No. 694348. In: Medical Malpractice Verdicts, Settlements & Experts 1998;14(2):43

The 50-year-old plaintiff had two liposuction surgeries of the hips, legs, and upper and lower abdomen performed. The plaintiff alleged that there was lack of informed consent, that parts of the outer thighs and hips were suctioned to the bone causing deformity, that a large amount of fat was removed leaving surrounding tissue draping over the areas, that the fatty tissue of the abdomen was removed unevenly leaving the pubic area deformed, that the liposuction resulted in bladder incontinence, and that an untrained person performed the liposuction. The defendant claimed that all the allegations were false and that there was no breach in the standard of care. There was a confidential settlement.

Comment: Liposuction is a medical procedure and should only be performed by a physician. Any other person performing the liposuction in a doctor's office may subject the physician to revocation of his state license since this would be considered aiding and abetting the unlicensed practice of medicine. A common known risk of liposuction is deformities, indentations, grooves, and uneven removal of fat. When there is excessive deformity, juries might be convinced that the surgeon did not know what he was doing, was incompetent, or careless. As stated by Illouz, "It is not so much what is removed that is important, but what is left behind" [2].

27.6.4 Medical Board of California v O'Neill, Case No. 09–93–26899, 1998

The State alleged, with regard to patient V.F., that the respondent had a custom fitted garment ordered for the patient months earlier and before she had gained 21 lbs, that there was no preoperative workup prior to the surgery, that blisters under the garment postoperatively followed by cellulitis were not recognized and treated as a serious soft tissue infection resulting in the need for additional surgery, that there was failure to provide adequate medical coverage by a physician experienced in liposuction surgery when the respondent left the area, and that this constituted unprofessional conduct and gross negligence.

The State alleged, in regard to patient B.L., that the respondent failed to properly assess whether the77-year-old female with a history of hiatal hernia and deep vein thrombosis following knee replacement surgery was a proper candidate for liposuction of the abdomen and hips, that the instillation of 5,100 cc of tumescent anesthesia fluid (total aspirate of 4,150 cc) was excessive in an ambulatory setting, and that this constituted unprofessional conduct.

There was a stipulated settlement and Disciplinary Order.

Comment: In the case of V.F., there was failure to recognize the fact that the patient gained weight and that the preordered garment would not fit properly. There was failure to recognize and treat an infection in a timely fashion. Infection is a known risk of any surgery and early recognition is essential. Coverage of a surgeon's practice should be by a surgeon who is experienced in the care and treatment of the types of procedures done by the original surgeon.

In the case of B.L., an elderly patient may not be a good candidate for surgery by that would depend on the patient's overall medical condition and the extent of the proposed surgery. There should be some consideration for the procedure to be done in the hospital. Removal of 4,150 cc of total aspirate is not excessive in an outpatient setting.

27.6.5 Medical Board of California v Greenberg, Case No. 04-97-76124, OAH No. L-1999020165, 1998

Disciplinary action brought for gross negligence, incompetence, and repeated negligent acts because of infections involving acid-fast bacilli in 34 liposuction patients. Fourteen patients met the definition for a confirmed case (12 positive cultures, 2 acid-fast bacilli on stain), and 20 patients met the clinical case definition. Cultures of *Mycobacterium cheloni* in patients matched the unique strain of the bacteria collected from the office faucet plumbing. Alleged failure to perform preoperative history and physical examination, failure to order preoperative lab work, failure to follow sterile technique through reuse of tumescent solution infusion tubing, reuse of liposuction tubing, inadequate removal of *M. chelonae* or failure to disinfect, and improper use of the autoclave, failure to investigate the causes of infection with sufficient thoroughness, and withholding information from subsequent patients concerning the precious infections, thereby placing numerous of his patients in jeopardy of infection.

Allegations concerning another patient included failure to perform adequate preoperative history and physical examination in a patient who had massive large-volume liposuction (11,700 cc aspirate), failure to require the patient to undergo a weight-control program prior to liposuction, failure to see or evaluate the patient within a few days of the surgery creating the unreasonable risk of missing the diagnosis of any massive fluid shifts or imbalances and metabolic changes, performance of the procedure in a patient who was not a candidate for liposuction resulting in large grooves and depressions in many areas of the body.

There were also allegations of aiding the unlicensed practice of medicine by allowing an untrained and unlicensed employee insert a liposuction cannula in more than one patient.

There was a stipulated settlement and disciplinary order.

Comment: In 34 infected patients, the physician should have been using sterile precautions and reevaluated his sterilization procedures as soon as the first cases began to appear. The physician had a habit of reusing intravenous solutions, unsterile liposuction tubing, and unsterile towels in surgery although the infections were more likely from inadequately sterilized cannulas. There was failure to timely diagnose the infections, take adequate cultures to diagnose mycobacterium, and to inform other patients that there was a problem with infections in prior patients having liposuction.

In one patient, there was failure to record any attempt at preoperative weight loss when proposing a very large liposuction. The usual treatment of obesity is

weight loss prior to attempts of liposuction. The surgeon should evaluate every postoperative patient, who is at risk for fluid imbalance, at short intervals of time after surgery. The patient might have been a candidate for large volume liposuction if there were attempts at weight loss prior to surgery. Grooves and depressions are a known risk of liposuction and do not occur because the patient is overweight.

27.6.6
Board of Medical Examiners of the State of Nevada v Schmerler, Case No. 00-9279-1, 2000

Concerning patient A, the allegations were that liposuction of the abdomen was performed in such a manner as to cause an abdominal wall infected hematoma with spotty necrosis of the subcutaneous tissue and fascia.

Concerning patient B, liposuction was performed on the abdomen and other areas of the body that resulted in four perforations of the bladder and as a result thereof constitutes malpractice. Also alleged was that the respondent had the patient enter into a written agreement preoperatively that since $10,000 is deducted from the cost of the surgery of $15,000, the patient waived the right to bring any complaint or medical lawsuit against the respondent. This constituted conduct with the intent to deceive.

Comment: In patient A, the fact that hematoma and spotty necrosis of the subcutaneous tissue and fascia occurred are not necessarily a result of the manner in which the procedure was performed but are known complications of the procedure. Necrosis of subcutaneous tissue and fascia is a result of infection from organisms causing small vessel thrombosis followed by necrosis.

In patient B, the bladder perforations are the result of failure to continuously monitor the end of the cannula with the non-dominant hand. Perforation of an intra-abdominal viscus is a known complication of the procedure. The agreement entered into with the patient to prevent litigation for future negligence is not considered by law to be enforceable. The attempt to reduce the cost of the surgery by overinflating the initial price and then giving a reduction in price as compensation for signing the agreement is considered fraud.

27.6.7
Carmona v Robertson, Dade County (FL) Circuit Court, Case No. 95 – 17130. In: Medical Malpractice Verdicts, Settlements & Experts 1998;14(8):55

The 25-year-old plaintiff had liposuction of the abdomen. Several scars across the abdomen occurred postoperatively. The defendant did not have malpractice insurance and he filed bankruptcy after the lawsuit was filed. The case settled for $85,000 during the bankruptcy.

Comment: Postoperative scarring of the abdominal wall is usually the result of suctioning too superficially and injuring the subdermal plexus of vessels. This occurs from oversuctioning an area or from trying to leave too thin a layer of fat on the abdominal wall. Scars are a known complication of liposuction and can occur without negligence.

27.6.8
Shir v Burres, Santa Monica County (CA) Superior Court, Case No. SC 045-665. In: Medical Malpractice Verdicts, Settlements & Experts 1998;14(10):49 – 50

The 33-year-old plaintiff underwent abdominal liposuction. Postoperatively, she developed scarring, severe pain, swelling, and bruising of the abdomen. The Plaintiff alleged that the surgery was performed negligently and there was no informed consent. The defendant claimed that performance of the procedure complied with the standard of care, that the plaintiff was informed of the risks and that she fully consented to the procedure. There was a defense verdict.

Comment: Overenthusiastic liposuction of the abdominal wall can result in scarring, swelling, and bruising but these complications are a known risk of liposuction and can occur without negligence. There may be an indication of lack of patient rapport in a case like this.

27.6.9
Sanborn v Zollman, U.S. District Court, District of Ohio, Case No. 97-CV-16. In: Medical Malpractice Verdicts, Settlements & Experts 2001;17(2):57

The plaintiff, an attorney, had large volume liposuction. Three days later she complained of shortness of breath and dizziness. The following day the plaintiff was still experiencing the symptoms and she underwent a blood transfusion. The plaintiff alleged that she did not consent to the presence of surgical assistants and another physician during the procedure and there was negligence in delaying the blood transfusion for one day. The defendant claimed that the procedure was appropriately performed and that his decision as to when to give the blood transfusion was appropriate. There was a defense verdict.

Comment: The surgeon was competent enough to recognize the possibility of blood loss as the cause of the symptoms. There was a timely transfusion. There is an indication that perhaps the surgeon failed to adequately explain to the patient the risks of liposuction and that patient-physician rapport was not very good.

27.6.10
Stecko v Martinez-Viera, Harris County (TX) District Court, Case No. 1998-58483. In: Medical Malpractice Verdicts, Settlements & Experts 2001;17(3):55

The plaintiff had abdominal liposuction in 1990 by the defendant. She underwent a second abdominal liposuction in December 1996 and postoperatively developed severe contour irregularities, depressions, dimpling, and seroma in the left lower quadrant of the abdomen. In April 1997, the defendant repaired the deformities and drained the seroma. The surgery resulted in a scar, skin adhesions, and left lower quadrant nerve damage. In September 1997 she underwent fat grafts by another surgeon to solve some of the problems. The plaintiff alleged that the defendant used an improper technique to perform liposuction, she was fraudulently induced by the defendant's advertisement into having the surgery, that there were no postoperative photos taken after the 1996 procedure, that there were no pre- or postoperative photos taken in 1997, and that what photos did exist were thrown away by the defendant. The defendant claimed that the plaintiff's first surgery caused scar tissue that affected the outcome. There was a confidential settlement during trial.

Comment: Photos are an essential part of cosmetic surgery and preoperative as well as postoperative photos are the standard of care. Destruction of a portion of the medical record (the photos) is considered spoliation and places the burden of proof on the defendant to prove that what he says is true. Scars, skin adhesions, and nerve injury are known complications of liposuction and in and of itself do not necessarily prove negligence.

27.6.11
Donnell-Behringer v McCann, Los Angeles County (CA) Superior Court, Case No. VC26507. In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(8):50

The 45-year-old plaintiff had liposuction as an outpatient and was seen on the 1st and 2nd postoperative days by the defendant. On the 3rd postoperative day she was admitted to the hospital by another physician for infection that had to be treated surgically. The plaintiff alleged that the liposuction was performed negligently with failure to use proper surgical techniques and was negligent in the follow-up care. The defendant claimed that the standard of care had been met and that infection is a known complication of the procedure. There was a verdict for $902,000 that was reduced to $660,00 through MICRA.

Comment: Any surgeon should be able to diagnose a postoperative infection in a timely fashion. Failure to make the diagnosis and treat in a timely fashion is usually considered negligence. Infection is not a result of improper surgical technique or negligence.

27.6.12
Taylor v Graves, San Diego (CA) Superior Court, Case No. 694348

The 50-year-old, 5' 4", 230-lb female plaintiff had liposuction by the defendant. At the first liposuction procedure, 11,000 cc was removed from the hips, legs, and abdomen and 4,000 cc removed at the time of a second procedure. The plaintiff developed postoperative urinary incontinence. The plaintiff alleged that there was lack of informed consent, that the surgery should not have been performed on a morbidly obese patient, that the urinary incontinence was caused by the trauma of liposuction, that the defendant had a medically untrained employee who cleaned instruments, acted as surgical assistant, and had performed liposuction on other patients, and that the indentations and irregularities of the hips and abdomen were from negligent surgical technique by an untrained healthcare employee. There was a confidential settlement.

Comment: Liposuction in a morbidly obese patient is not contraindicated if other means of weight loss have been unsuccessful. Urinary incontinence is a risk of liposuction and does not mean that there was negligence. Allowing liposuction to be performed by an unlicensed individual is illegal and, therefore, the surgeon is liable for any injuries.

27.6.13
Tillery v Pottle, New Hanover County (NC) Superior Court, Case No. 94CvS942 (1996)

The 35-year-old plaintiff had abdominal liposuction in 1993 by the defendant using a dry technique. A 4-mm Mercedes cannula was used through stab wounds in the suprapubic midline and lateral abdominal areas. The total aspirate was 1,950 cc with an estimate of 700 cc blood loss. This was the defendant's 11th liposuction case. The surgery was performed under general anesthesia with the patient's abdomen in a slightly extended position. Postoperatively, in the recovery room, the patient complained of marked abdominal discomfort and was observed overnight. On the first postoperative day, the abdominal pain was less but bowel sounds were diminished. On the 2nd postoperative day, the patient was called and explained that there was shortness of breath. She went to the hospital emergency room that same day at which time the bowel sounds were diminished and abdominal X-rays showed intra-abdominal free air. Exploratory laparotomy disclosed 10 – 15 perforations of the abdominal wall with over 30 puncture wounds of the small bowel mainly clustered around the umbilicus. The perforations were repaired and postoperatively a seroma had to be aspirated. The plaintiff alleged that the defendant negligently performed liposuction perforating the intestines, failed to make a

timely diagnosis of the perforations, and failed to take appropriate steps to remedy the situation. The damages claimed were serious, permanent, and painful injuries, scarring and disfigurement, additional surgeries, mental anguish, and emotional distress. The defendant claimed that his performance was not below the standard of care and that the complication was a known risk of the procedure. There was a $490,000 settlement.

Comment: There appeared to be failure of the inexperienced liposuction surgeon to use the non-dominant hand to palpate the end of the cannula, especially the thin infusion cannula. Without knowledge of where the cannula tip is at all times, there is a possibility of perforating the abdominal wall. There was delay in the diagnosis and treatment of the intestinal perforations following the defendant's knowledge of the symptoms of dyspnea. Abdominal X-rays shortly postoperatively when the patient was complaining of increased abdominal pain would probably have led to an earlier diagnosis.

27.7 Abdominoplasty

27.7.1

Adshade v Kiener, Washoe County (NV) District Court, Case No. CV 95-06967. In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(10):55

The 39-year-old female plaintiff had abdominoplasty to remove fat and stretch marks. She felt that the contouring was inadequate and underwent two further procedures by the defendant to correct this. The plaintiff alleged that the defendant fell below the standard of care in his performance of the first two procedures (two plastic surgeon expert witnesses supported her contentions). The defendant claimed that the second surgical procedure was performed specifically to appease the plaintiff. There was a defense verdict.

Comment: Abdominoplasty may result in irregularities and can be considered inadequate to the patient. However, an inadequate result is not necessarily because of negligence.

27.7.2

Kent v Berry, Deschutes County (OR) Circuit Court, Case No. 97CV0115MS. In: Medical Malpractice Verdicts, Settlements & Experts 1998;14(5):40

The 59-year-old plaintiff had an abdominoplasty. She developed delayed healing with skin slough and scarring. The plaintiff alleged that there was failure to appropriately allow for skin closure with her preexisting vertical abdominal scar. There was a defense verdict.

Comment: Necrosis of the abdominal wall is a known risk of abdominoplasty. The surgeon must take into consideration any prior abdominal scars in planning the procedure. A vertical midline scar would not affect the closure in abdominoplasty.

27.7.3

Grasso v Capella, Rockland County (NY) Supreme Court, Case No. 2879/95. In: Medical Malpractice Verdicts, Settlements & Experts 1998;14(9):57

The 52-year-old plaintiff, with a history of gastric bypass surgery and 130-lb weight loss, had abdominoplasty. Skin necrosis occurred. The plaintiff alleged that the defendant negligently performed the surgery by pulling the skin too tight and cutting off the circulation resulting in necrosis. The defendant claimed that the complication was a known risk of the procedure. There was a $90,000 verdict

Comment: Skin necrosis following abdominoplasty is a known risk and when it occurs is not usually considered negligence. Pulling the skin tight is part of the procedure and vascular deprivation can occur. There is an indication that the surgeon may not have discussed the possible risks adequately and that there was not adequate rapport with the patient.

27.7.4

Small v Glick, Los Angeles County (CA) Superior Court, Case No. SC 047-622. In: Medical Malpractice Verdicts, Settlements & Experts 1999;15(8):36

The 52-year-old plaintiff had abdominoplasty performed by the defendant. She developed a seroma across the whole abdominal wall that required multiple aspirations over 11/2 years. The Seroma cavity ultimately had to be removed surgically. The plaintiff alleged that the defendant failed to placed an appropriate number of drains in the abdominal wall that resulted in the development of the seroma and that there was inadequate informed consent in that the plaintiff, though she was undergoing a small tummy tuck, actually had a radical abdominoplasty with a scar that traversed her waistline. The defendant claimed that seromas are a known complication of the procedure and that there was no negligence. There was a defense verdict.

Comment: Postoperative seroma is a known complication of abdominoplasty. The treatment of the seroma may not have been adequate. Frequent aspiration and compression following surgery may have helped. When the pseudocyst became chronic, the fluid aspiration could have been followed by injection of air into the cavity with resolution of the cyst or the cyst wall could have been curetted. If these failed, then excision should have been recommended before another surgeon treated the patient.

27.7.5
Wiener v Bunkis, Contra Costa County (CVA) Superior Court, Case No. C99-00074. In: Medical Malpractice Verdicts, Settlements & Experts 2001;17(6):50

The plaintiff underwent abdominoplasty. The defendant saw her on the 6th and 10th postoperative days. On the 12th postoperative day she called the defendant complaining of fever, bloating, and inability to urinate. She was examined by the defendant and catheterized. She developed renal failure from the urinary retention and required hospitalization. The plaintiff alleged that she called the defendant on the 3rd and 5th days postoperatively complaining of inability to urinate, that she complained on the office visits of inability to urinate, and that the urinary retention was not timely treated. The defendant claimed that he was not informed of the urinary retention and that if he had been, he would have immediately catheterized her and referred her to a urologist for evaluation, and that the urinary retention probably started on the 10th postoperative day. There was a defense verdict.

Comment: Urinary retention is a rare complication of abdominoplasty but is not a result of negligence. Diagnosis of the condition was timely, according to the surgeon. The medical record is the physician's best defense and should contain all information on every patient phone call.

27.7.6
J.S. v Dr. S (SD). In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(3):47

The 29-year-old plaintiff's decedent had an outpatient abdominoplasty. The blood loss, tissue removed, and fluid drainage after surgery were substantially more than the fluid received. The patient was discharged based on the family's statement that they would obtain a hotel room in town. The family could not get a hotel room and drove 50 miles home. Several phone conversations were held with the defendant because of pain and continued drainage. The defendant told the family to take the patient to a local emergency room or bring him back to the office. An ambulance was called and the patient was transported to a local emergency room where he suffered a cardiopulmonary arrest. He was stabilized and transported to a larger facility where he subsequently arrested and was not able to be resuscitated. Autopsy showed multiple organ system failure, postoperative hemorrhage, and hemorrhagic shock. The plaintiff alleged that the decedent should have been admitted to the hospital postoperatively for monitoring, had fluid infusion and this would have prevented the death. The defendant claimed that he scheduled the surgery when he had been assured that the patient would be staying in a local hotel that would have allowed follow-up evaluation, that if he had known the arrangements had not been made he would have postponed the surgery, and that if the decedent had been nearby, he would have survived. There was a $160,000 settlement.

Comment: In the situation where a patient from out of town has surgery, it is the surgeon's responsibility to make sure arrangements for postoperative care are made before surgery. The surgeon should have advised the patient to be seen at the local hospital much sooner when there were problems that required the patient's family to call.

27.7.7
Argenziano v Romita, New York County (NY) Supreme Court, Index No. 121386/94. In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(5):47–48

The 37-year-old plaintiff underwent abdominoplasty and panniculectomy at which time six pounds of fat was removed. The plaintiff alleged that the defendant was negligent for making the incision line while she was on the operating table and not in an upright position resulting in an irregular scar and misplaced umbilicus, that the umbilicus was improperly resected resulting in an over two-inch protrusion of the umbilicus, that her rectus muscles were improperly plicated causing an expanded waist line, that the incision was closed too tight resulting in a distorted mons pubis and unhooded clitoris, and that staples should not have been used to close the wound. The defendant claimed that the procedure was properly performed, that incisions were properly closed, and that it was correct to leave the umbilicus long because of the patient's weight and amount of skin that had to be removed. Evidence indicated that the plaintiff had undergone numerous other plastic surgeries that required subsequent repair. There was a defense verdict.

Comment: An overweight patient with a hanging panniculus should first be marked while standing and then any adjustments can be made while the patient is lying down. In the supine position, the panniculus tends to fall to one side or another and distorts the incision site and the position of the umbilicus. Many times the patient's umbilicus is off to one side preoperatively. This must be noted on the chart and pointed out to the patient before surgery. A protruding umbilicus is the result of not fixing the umbilical stalk to the underlying fascia. The principles of a good-looking umbilicus require that the umbilical stalk be pulled inward. Staples are commonly used to close abdominoplasty wounds and are not a breach of the standard of care. Distortion of the mons pubis and unhooding of the clitoris is a result of too tight a closure but is not necessarily negligence since these are known risks of the procedure.

27.7.8
Lieu v Moglen, San Francisco County (CA), Case No. 98 51 33. In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(9):58

The 38-year-old plaintiff's decedent had an abdominoplasty procedure performed by the defendant under conscious sedation administered by the Registered Nurse, who assumed the responsibility of monitoring. During surgery, the decedent's breathing became slower and shallow. Pulmonary arrest occurred and paramedics were called resulting in a successful resuscitation. She suffered severe neurologic damage from oxygen deprivation and was maintained on life support for a few days but this was discontinued when family members learned she was brain dead. The plaintiff alleged that the Registered Nurse owed a duty to the decedent to monitor, report, and respond to any significant changes in the decedent's vital signs, that the defendant Registered Nurse failed to timely report to the physician defendant a marked drop in blood pressure and oxygen saturation levels (48 %) and to administer oxygen and narcotic reversants, and failed to call 911 in a timely manner. The defendant Registered Nurse claimed that she met the standard of care in the monitoring of vital signs, that she followed the directions of the surgeon and she is not separately liable for mistakes committed by the surgeon, and that the precise cause of death was unrelated to the nursing care provided. There was a $580,652 arbitration award with the surgeon 80 % negligent and the nurse 20 % negligent for the noneconomic damages and 100 % liable for the economic damages.

Comment: The operating surgeon has responsibility for the actions of healthcare personnel who are under his direction and control. The Registered Nurse should have been trained by the physician or taken courses in administering conscious sedation and not simply recorded vital signs without knowing when there was a problem. The RN should have already had the training to respond to a critical situation such as drop in the oxygen saturation. Patient safety would have been better served by the presence of an anesthetist or anesthesiologist when conscious sedation was being given.

27.8 Combination Abdominoplasty and Liposuction

27.8.1
Bogert v Lentz, Volusia County (FL) Circuit Court. In: Medical Malpractice Verdicts, Settlements & Experts 1998;14(7):50

The 69-year-old plaintiff's decedent had liposuction and abdominal panniculectomy. She had a history of multiple prior surgeries. A hernia was discovered and repaired during the panniculectomy. The bowel was injured and this was followed by sepsis. The sepsis was treated but she died of complications. The plaintiff alleged that she was not a candidate for the procedure and that the defendant was negligent in the performance of the surgery. The defendant claimed that the complication was a known risk of the procedure and that it was handled properly. There was a $250,000 settlement.

Comment: Repair of a hernia is not necessarily a simple procedure. When the base of the hernia is exposed, the dissection of the sac may require opening the peritoneum in order to prevent injury to the underlying bowel. Any underlying bowel adherent to the sac must be dissected off under direct visualization and checked very carefully for injury to the seromuscular layer or mucosa of the bowel. Any injury to the bowel wall has to be repaired immediately. Any sutures placed in the fascia to close a hernia must be placed with complete visualization of the entry and exit points of the needle.

27.8.2
Hull v Ghorbani, Contra Costa County (CA) Superior Court, Case No. C99-02770. In: Medical Malpractice Verdicts, Settlements & Experts 2001;17(6):50

The plaintiff had abdominoplasty with liposuction and subsequently developed necrosis at the midpoint of the suture line. The wound took 6 months to heal. The plaintiff alleged that there was failure to warn her of the risks that included necrosis, that there was a breach in the standard of care in the defendant's postoperative care, and that the defendant could have cut the sutures to relieve the tension and improve the blood supply. The defendant claimed that the plaintiff was informed of the risks of surgery and that cutting the sutures would not have changed the ultimate outcome. There was a defense verdict.

Comment: There appears to be inadequate communication between the surgeon and the patient concerning the possible complications of abdominoplasty especially in combination with liposuction. Necrosis is a known complication of the procedure and may not be associated with a breach in the standard of care. Cutting the sutures to relieve tension would probably have resulted in wound dehiscence and prolonged healing.

27.8.3
Kaplan v Nadler, Suffolk County (NY) Supreme Court, Index No. 27065/95. In: Medical Malpractice Verdicts, Settlements & Experts 2000;16(9):59

The 43-year-old plaintiff underwent abdominoplasty and liposuction by the defendant. The defendant failed to diagnose an infection on follow-up examination and

she was admitted to the hospital 12 hours later, remaining hospitalized for 1 month. The plaintiff alleged failure to diagnose and treat a postoperative infection. The defendant claimed that there was no redness or swelling when patient was at his office (this was noted in the records), that beta hemolytic streptococcus infection is extremely aggressive and manifests itself quickly, and that the doctors at the hospital failed to diagnose and treat an abscess or obtain a plastic surgery consultation and improperly drained the infection through the plaintiff's skin instead of reopening the wound. There was a defense verdict.

Comment: Infection following abdominoplasty with liposuction is a known complication. The surgeon's medical record of the condition of the wound at the time of the office visit was his best defense.

27.8.4 Pasalich v Swanson, Clay County (MO) Circuit Court, Case No. CV1976516CC

The female plaintiff underwent abdominoplasty and liposuction. Pulmonary edema and scarring occurred. She alleged failure to inform about the risks of the procedure and was given too much fluids during the surgery that caused pulmonary edema and required 6 days of hospitalization. The defendant claimed that the plaintiff was informed of the risks, including scarring, and that she did not have pulmonary edema. There was a defense verdict.

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