Liposuction

BY

Allen Gabriel, MD, Director of Research, Department of Plastic Surgery, Loma Linda University School of Medicine Mary Katherine Gingrass, MD, FACS, Assistant Clinical Professor, Department of Plastic Surgery, Vanderbilt University; Consulting Surgeon, The Plastic Surgery Center of Nashville; Martha Matthews, MD, Head, Department of Surgery, Division of Plastic Surgery, Cooper Hospital University Medical Center; Assistant Professor, Department of Surgery, University of Medicine and Dentistry of New Jersey; Julian B Gordon, MD, Consulting Staff, Division of Plastic Surgery, Kennestone Hospital; Consulting Staff, Department of Surgery, Division of Plastic Surgery, Northside Hospital-Cherokee

Introduction

Liposuction has become the most popular cosmetic procedure performed by board-certified plastic surgeons in the United States.[1] Although liposuction is not a technically difficult procedure, it requires thoughtful planning and an artistic eye to achieve aesthetically pleasing postoperative results. The goal of the liposuction surgeon is to remove "target" fat, leaving the desired body contour and smooth transitions between suctioned and nonsuctioned areas. Careful selection of patients and proper surgical technique help avoid contour irregularity, and diligent perioperative care of the patient helps avoid postoperative complications.

History of the Procedure

Accounts of human interest in body weight and contour can be found throughout history.[2] Some of the simplest attempts to change body shape and appearance can be observed in the vast array of clothing used to hide, compress, and mold the human figure. Surgical procedures were devised to alter actual body shape permanently.[2] In 1921, Dujarrier used an obstetric uterine curette to remove fat from the knees of a ballerina. The patient sustained irreparable injury and was left with the horrendous result of an eventual amputation.

In 1978, Kesselring and Meyer reported the use of a suction-assisted curettage method in which sharp curettage and strong suction were employed to remove fat.[3] In the early 1980s, surgeons such as Illouz and Fournier began using suction cannulae without sharp curettage to remove subcutaneous fat.[4,5] Illouz, in the early part of 1980, also introduced the concept of "wet" liposuction. This technique incorporates an injection of saline into the subcutaneous space before performing liposuction. He found this reduced blood loss and assisted in obtaining smoother, more satisfying results. This technique currently is used most often in liposuction procedures.

In 1978, Kesselring and Meyer reported the use of a suction-assisted curettage method in which sharp curettage and strong suction were employed to remove fat.[3] In the early 1980s, surgeons such as Illouz and Fournier began using suction cannulae without sharp curettage to remove subcutaneous fat.[4,5] Illouz, in the early part of 1980, also introduced the concept of "wet" liposuction. This technique incorporates an injection of saline into the subcutaneous space before performing liposuction. He found this reduced blood loss and assisted in obtaining smoother, more satisfying results. This technique currently is used most often in liposuction procedures.

Traditional suction-assisted lipoplasty (SAL) became popular in the United States in the 1980s. It has a long track record and is considered the criterion standard tool for liposuction.[6] Increased support for advancing this procedure to more complex cases has been demonstrated successfully when used in the proper patients. Ultrasound-assisted liposuction (UAL) was introduced in the United States in the mid 1990s to address some of the shortcomings of SAL. Interestingly, this procedure gained popularity quickly in the management of gynecomastia.

Ultrasound medical devices have been used in other fields (eg, neurosurgery, otology, ophthalmology, urology) for a number of years and have proven to be extremely useful and safe. UAL has been used in tens of thousands of plastic surgery cases in Europe and in other countries outside of the United States for approximately 25 years. Plastic surgeons who have used these devices have been extremely enthusiastic about them,[7] and they became more popular in the United States over the turn of the century. Some surgeons think that these devices are superior tools for sculpting and find less need for cross-tunneling compared with SAL.

Problem

Fat is deposited in the subcutaneous layer in almost all areas of the body. Fat is a normal component of the subcutaneous tissue layer. Fat cells may not be distributed evenly, causing some areas to be more prominent than is ideal. Liposuction is a surgical procedure that attempts to contour specific areas of fat accumulation that patients see as undesirable.
Frequency
According to the American Society for Aesthetic Plastic Surgery (ASAPS) 456,828 liposuction procedures were performed in the United States in 2007. Liposuction is the most commonly performed cosmetic procedure in the United States.[1]

Pathophysiology
Patterns of fat distribution differ among races, ages, and sexes. The actual number of fat cells remains stable during adult life. The cells get larger with weight gain and smaller with weight loss. In general, women have a proportionately higher percentage of body fat than men. Women typically have a disproportionate number of fat cells in their hips, upper thighs, and buttock, while men tend to have a more even distribution of fat cells in the trunk. Also, liposuction is effective in changing contour because it permanently removes fat cells that are distributed unevenly. The remaining fat cells still can store fat. Therefore, liposuction affects weight distribution but cannot prevent further weight gain.

A progressive accumulation of fat occurs intra-abdominally as a person ages. This intra-abdominal fat is not treated by liposuction, thus must be differentiated carefully from subcutaneous fat when evaluating a patient for surgery.

Indications
The ideal liposuction patient is healthy, eats a well-balanced diet, has good skin elasticity, desires treatment of minimal-to-moderate localized fat deposits, and is within 20-30% of ideal body weight. Note localized excess fat on the hips, inner thighs, and outer thighs in the image below.

Modern liposuction techniques allow treatment of a much broader range of patients. New "super volume" liposuctions allow for treatment of patients with more generalized lipodystrophy. For more information, see eMedicine article Liposuction, Large Volume: Safety and Indications. In addition, ultrasound-assisted liposuction (UAL) has afforded good results in patients with fatty deposits that were poorly responsive to traditional liposuction.

Although beyond the scope of this chapter, excisional surgery (e.g., abdominoplasty or tummy tuck) has specific indications to treat problems such as severe skin laxity and truncal obesity in patients with poor skin elasticity. Excisional surgery and liposuction are often combined for an optimal result in certain patients.

Evaluation
A liposuction consultation should begin by asking the patient the following questions:
• What would you like to change about your body?
• What is your current weight?
• How long have you been at this weight?
• Have you had any significant weight gains or losses?
• What is your current diet and exercise regimen?
• For how long have you maintained this regimen?
• Have you taken any diet pills to assist with weight reduction?
• Have you had previous liposuction?
• How will your life responsibilities allow for recovery time?

Relevant Anatomy
Two main layers of subcutaneous fat, deep and superficial, are present. Liposuction primarily is focused on the deeper layer of fat, since suctioning is safer and easier there. Suctioning in the superficial layer allows the surgeon to achieve subtle benefits in the procedure[8] but, because of its superficial location, increases risks of contour irregularities and injury to the skin. Others claim that superficial liposuction enhances skin retraction.

Contraindications
Liposuction carries greater risk for patients with significant medical problems. Heart disease, lung disease, diabetes, and peripheral vascular disease pose serious risk during any surgical procedure. Smoking or a recent history of smoking is a strong risk factor. Patients who have undergone previous surgery in the area to be contoured are at risk of surgical complications during liposuction. Surgery alters the local anatomy and distorts the normal subcutaneous planes in which liposuction is performed, increasing the chances of injury to local tissues.

Workup
Laboratory Studies
• A CBC is especially important when performing large volume liposuctions, in which a large blood volume may be lost.
• Some providers recommend clotting studies, electrolytes, urinalysis, and radiographs.
• If smoking is suspected, a urine COTININE test can be obtained.

Imaging Studies
• Obtain a chest radiograph as indicated by patient age and medical history.

Other Tests
• During the history and physical examination, pay specific attention to the possibility of hernias, scars, and masses.
• Perform relevant preoperative studies (eg, ECG) as indicated by patient age and medical history.
• Obtain a set of standard photographs. These serve as an intraoperative surgical guide and enable comparison of preoperative and postoperative results.

Treatment
Surgical Therapy
Historically, 4 different infiltration techniques have been used for suction-assisted lipectomy (SAL): dry, wet, superwet, and tumescent.

Dry
• No fluid is injected into the subcutaneous fat layer before suctioning.
• Approximately 25-45% of the aspirated volume is blood.
• This technique is not used commonly except for small volume suctions.

Wet
• Illouz pioneered this technique in the early 1980s.
• It consists of an infusion of 100-300 cm³ of saline into each site of fat to be removed before suctioning.
• The aspirated blood volume is lowered to 20-25% of the total aspirate.
• Hettler's addition of 1:200,000 or 1:400,000 epinephrine to the presuctioning fluid in 1983 reduced blood loss even more. Less than 15% of the aspirate was blood.

Superwet
• This technique was devised in the late 1980s.
• It consists of an infusion of fluid containing epinephrine and low doses of local anesthetic in a 1:1 ratio to the volume of expected aspirate.
• Blood loss is reduced to approximately 2% of the aspirated volume.

Tumescent
• In the tumescent technique, large volumes of dilute lidocaine and epinephrine are injected into the subcutaneous fat before the procedure.[9,10]
• Klein described this technique in 1990.[11]
  o Large volumes of saline containing 1:100,000 epinephrine and 0.05% lidocaine were injected subcutaneously before suctioning until the tissues were tense.
  o The injected fluid volume was greater than that expected to be suctioned.
• Blood loss is approximately 1% of the aspirated volume.

Much debate exists between proponents of the superwet and tumescent techniques. Most modern liposuction is a combination of these 2 techniques.

The series of photographs below shows a patient before and after tumescent liposuction.

Liposuction, trunk. Posterior view of patient before tumescent suctioning. Note the excess fat on the hips, inner thighs, and outer thighs.
Liposuction, trunk. Frontal view of patient before tumescent suctioning. Note the excess fat on the hips, inner thighs, and outer thighs.

Liposuction, trunk. Posterior view 3 months after 3 L of tumescent liposuction without ultrasound assistance. A reduction in the total fat on the hips and thighs is readily seen. A smooth "hourglass" contour has been obtained.
Liposuction, trunk. Frontal view 3 months after 3 L of tumescent liposuction without ultrasound assistance. A reduction in the total fat on the hips and thighs is readily seen. A smooth "hourglass" contour has been obtained.

Intraoperative Details

Standard liposuction

- Make small stab incisions along relaxed skin tension lines.
- Inject the presuctioning fluid.
- Introduce the suction cannulae into the deep fat layer.
- Activate the vacuum and push the cannula to and fro through the fat, creating a radial pattern.
- Use multiple incision sites to overlap the fan patterns. This technique helps prevent contour irregularities.
- If needed, use smaller caliber cannulae to suction the superficial fat layer in a similar fashion. Take care not to injure the skin or to create contour irregularities caused by the superficial location of this fat.
- Close access wounds with 1-2 buried absorbable sutures. Place sterile dressings.
- Place a fitted compression garment over the treated areas; some believe that it must be worn continuously for at least 2 weeks.
- Close access wounds with 1-2 buried monofilament nonabsorbable sutures.

Ultrasound-assisted liposuction

- Infuse similar presuctioning fluids into the subcutaneous fat layers.
- Add ultrasonic energy to emulsify the fat cells.
- Ultrasound can be performed before suctioning using solid probes or it can be added directly to the suction cannula, enabling simultaneous liquefaction and suctioning of fat. A 3-step procedure is incorporated.
- Ultrasonic energy is exothermic, so it can cause heat injury to surrounding tissues. This may improve the results of liposuction by increasing contraction of skin and subcutaneous tissues, but it increases the risk of injury to the skin during superficial suctioning.
- Ultrasound-assisted liposuction (UAL) allows treatment of areas (ie, back, upper flank, chest, male breast) that previously did not respond well to conventional liposuction.
- The cosmetic treatment of the male patient with gynecomastia has been revolutionized by the use of UAL. Excellent results have been realized with minimal scarring, avoiding the previously required scars of mastectomies.
Note: The ultrasonic energy used in UAL is delivered via the cannulae as they are passed through the fat layers. Devices do exist that deliver ultrasonic waves transcutaneously, but these have not been shown to be helpful.

Postoperative Details

Once the final contouring is performed, the incisions are closed. Incisions for cannulae larger than 3.0 mm are generally closed with a 5-0 nylon suture. Some surgeons recommend leaving smaller incisions open to allow wetting solution to drain. The patient is dressed in a compression garment that covers the areas that have been suctioned. Compression foam (TopiFoam) under the garment seems to decrease bruising and swelling in the early postoperative period. An abdominal binder and compression foam can be used when the hips and abdomen are suctioned alone. When thigh work is done as well, a girdle is preferable.

When drains are used, they are left in place until drainage is less than 30 mL in a 24-hour period. Foam padding should be left in place for 3-5 days. Compression garments are generally encouraged 23 hours per day for 4 weeks. Patients are warned that with larger volume liposuction, some patients experience lightheadedness (a vasovagal response) the first time the garment is removed. Therefore, someone should accompany the patient for the first dressing change.

Follow-up

Patients are instructed to remove their garments or foam and to take a shower after 1-3 days, depending on the amount of suction performed. When 1 or 2 areas are suctioned, the patient can typically replace the foam padding over the liposuctioned areas and replace the garment after the shower. When multiple areas are suctioned, the first dressing change is often better performed in the office.

Postoperative follow-up visits are scheduled at 5 days, 2 weeks, 6 weeks, 3 months, and 6 months. Patients experience red-tinged, serosanguineous drainage from incision sites for the first 24 to 36 hours. Maximal swelling can be expected during postoperative days 3-5. If the patient has bruising, it will usually resolve over 7-10 days.

The patient is instructed to begin lymphatic massage of the areas suctioned approximately 2 weeks after surgery. This reduces edema and helps reduce small contour irregularities. A referral to a massage therapist trained in Dr. Vodder's manual lymphatic drainage techniques[12]instructs the patient on proper massage technique, and many patients may choose to continue with the massage therapist. Manual lymphatic drainage is a common technique used to treat lymphedema patients and is useful in the treatment of liposuction patients the first 4-6 weeks. Patients can expect approximately 80% of the edema to resolve within 4-6 weeks; it takes a full 4-6 months for all of the swelling to resolve.

Patients should begin ambulating on the day of surgery. Oral fluids and a high-protein diet should be encouraged. Physical activity should be low for the first week, followed by a gradual increase in activity during the second week, depending on the amount of suction performed. At the end of the first or second week (depending on the amount of suction), the patient should be encouraged to get on a treadmill or walk outside (with compression garments on). Upper body conditioning can also begin. At 4-6 weeks, assuming edema and bruising are resolving appropriately, the patient should be advancing to full activity. These guidelines are general and must be tailored to the individual patient.

Return to work depends on many factors: the patient's profession, the amount of liposuction, the patient's general health, the patient's physical and emotional recovery, and the patient's desire to return to work. After an average medium-volume liposuction (2-4 L), most patients return to work in less than 1 week. They feel tired and sore but can function appropriately. For large-volume liposuction (>5 L), the average patient should schedule 2 weeks off work. Many patients who schedule small-volume liposuction (<2 L) desire surgery on Friday afternoon and plan to return to work on Monday. This can be done; anecdotally, patients who do not plan any recovery time seem to have a lot of early swelling and a prolonged eventual total recovery time.
Complications

Short-term complications

• Hypesthesia, paresthesias, edema, ecchymosis, hematoma, seroma, and infection usually resolve quickly and are not complicated. Hematomas and seromas may need to be evacuated with large needles or skin incisions. Infections often resolve with oral antibiotics although a low incidence of devastating necrotizing fasciitis has been reported.
• Fat emboli can be fatal but are rare.
• Skin necrosis can occur, usually as small areas. It usually can be treated conservatively with local wound care.
• Pulmonary edema has been reported as a complication of tumescent liposuction.

Long-term complications

• The most common long-term complication is contour irregularity. This is related to the surgeon's experience and may respond to massage therapy. Treat it conservatively for at least 6 months. Perform autologous fat grafting, further liposuction, or skin excision as needed. Various studies state minor revision rates of 2-10%.
• Skin color changes are rare but are more common with aggressive superficial ultrasound-assisted liposuction (UAL).

Specific incidences for the complications of liposuction are difficult to ascertain. Physicians of various specialties perform liposuction in hospitals, surgical centers, and private offices. The most devastating complication of liposuction, death, has been reviewed statistically. In January 2000, Grazer published an article in which he reported the fatal outcomes of liposuction using a census survey of cosmetic surgeons. He surveyed 1,200 actively practicing, board-certified North American aesthetic plastic surgeons who were members of the American Society for Aesthetic Plastic Surgery (ASAPS). Of those surveyed, 917 reported that from 1994-1997, 95 fatalities occurred after 496,245 lipoplasties. This yields a mortality rate of 1 in 5224 (<0.5%). This is similar to rates quoted elsewhere. Pulmonary thromboembolism was the major cause of death in 23.4 (±2.6%) of these deaths.

Outcome and Prognosis

Liposuction is an extremely effective surgical tool that affords excellent results. Patients still can gain weight after undergoing liposuction, but their shape remains more balanced than before the procedure. In most published studies on liposuction, approximately 10% of patients require a minor touch-up within a few months of surgery. In appropriately selected patients, liposuction performed by skilled surgeons yields patient satisfaction rates greater than 90%.

The multimedia section contains 3 sets of preoperative and postoperative photos of patients who underwent ultrasound-assisted lipectomy (UAL), suction-assisted lipectomy (SAL), or both.

Future and Controversies

Controversies exist regarding simultaneous use of liposuction with other procedures for body contouring. Some surgeons routinely perform liposuction while performing procedures such as abdominoplasty. Performing multiple procedures simultaneously carries a greater risk of complications. Abdominoplasties compromise blood flow to skin and fat in the treated and surrounding areas. Simultaneously adding the surgical trauma of liposuction to this therapy increases the chance of significant blood flow compromise to the tissues in the surgical zone. As more of these combined procedures take place and larger volumes of liposuction are performed, the limits of this surgical therapy will be defined more clearly.
Multimedia

Media file 1: Liposuction, trunk. Posterior view of patient before tumescent suctioning. Note the excess fat on the hips, inner thighs, and outer thighs.

Media file 2: Liposuction, trunk. Frontal view of patient before tumescent suctioning. Note the excess fat on the hips, inner thighs, and outer thighs.
Media file 3: Liposuction, trunk. Posterior view 3 months after 3 L of tumescent liposuction without ultrasound assistance. A reduction in the total fat on the hips and thighs is readily seen. A smooth "hourglass" contour has been obtained.

Media file 4: Liposuction, trunk. Frontal view 3 months after 3 L of tumescent liposuction without ultrasound assistance. A reduction in the total fat on the hips and thighs is readily seen. A smooth "hourglass" contour has been obtained.
Media file 5: Preoperative rear view of a 38-year-old woman with history of 1 prior pregnancy.

Media file 6: Preoperative front view of 38-year-old woman with history of 1 prior pregnancy.
Media file 7: Postoperative rear view of patient in media files 5-6, 1 year after UAL and SAL of the abdomen, hips, flanks, and circumferential thighs.

Media file 8: Postoperative front view of patient in media files 5-6, 1 year after UAL and SAL of the abdomen, hips, flanks, and circumferential thighs.
Media file 9: Preoperative front view of 42-year-old woman with a history of weight fluctuations.

Media file 10: Preoperative rear view of 42-year-old woman with a history of weight fluctuations.
Media file 11: Postoperative front view of same patient in media files 9-10, 1 year following UAL and SAL of the abdomen, hips, flanks, and circumferential thighs.

Media file 12: Postoperative rear view of same patient in media files 9-10, 1 year following UAL and SAL of the abdomen, hips, flanks, and circumferential thighs.

References


S:\Administration\Articles\2010 Revisions\Liposuction.docx


Contributor Information and Disclosures
Author
Allen Gabriel, MD, Director of Research, Department of Plastic Surgery, Loma Linda University School of Medicine
Allen Gabriel, MD is a member of the following medical societies: Alpha Omega Alpha, American Medical Association, and California Medical Association
Disclosure: Nothing to disclose.

Coauthor(s)
Mary Katherine Gingrass, MD, FACS, Assistant Clinical Professor, Department of Plastic Surgery, Vanderbilt University; Consulting Surgeon, The Plastic Surgery Center of Nashville
Mary Katherine Gingrass, MD, FACS is a member of the following medical societies: American Association of Plastic Surgeons, American College of Surgeons, American Medical Association, American Society for Aesthetic Plastic Surgery, American Society of Plastic Surgeons, and Tennessee Medical Association
Disclosure: Nothing to disclose.

Martha Matthews, MD, Head, Department of Surgery, Division of Plastic Surgery, Cooper Hospital University Medical Center; Assistant Professor, Department of Surgery, University of Medicine and Dentistry of New Jersey
Martha Matthews, MD is a member of the following medical societies: American Cleft Palate/Craniofacial Association, American College of Surgeons, and American Society of Maxillofacial Surgeons
Disclosure: Nothing to disclose.
Julian B Gordon, MD, Consulting Staff, Division of Plastic Surgery, Kennestone Hospital; Consulting Staff, Department of Surgery, Division of Plastic Surgery, Northside Hospital-Cherokee
Julian B Gordon, MD is a member of the following medical societies: American Society for Aesthetic Plastic Surgery, American Society for Reconstructive Microsurgery, American Society of Plastic Surgeons, and Sigma Xi
Disclosure: Nothing to disclose.

Medical Editor
Gregory Caputy, MD, PhD, Chief, Department of Plastic Surgery, Aesthetica Plastic and Laser Surgery Center of Honolulu
Gregory Caputy, MD, PhD is a member of the following medical societies: American Medical Association, American Society for Laser Medicine and Surgery, Canadian Medical Association, Hawaii Medical Association, International College of Surgeons, International College of Surgeons US Section, Pan-Pacific Surgical Association, and Wound Healing Society
Disclosure: Nothing to disclose.

Pharmacy Editor
Francisco Talavera, PharmD, PhD, Senior Pharmacy Editor, eMedicine
Disclosure: Nothing to disclose.

Managing Editor
Alan Matarasso, MD, FACS, PC, Clinical Professor of Plastic Surgery, Albert Einstein College of Medicine; Immed Past President of New York Regional Society of Plastic and Reconstructive Surgery
Alan Matarasso, MD, FACS, PC is a member of the following medical societies: American Association of Plastic Surgeons, American College of Surgeons, American Medical Association, International College of Surgeons, International College of Surgeons US Section, New York Academy of Medicine, New York County Medical Society, Pan American Medical Association, and Pan-Pacific Surgical Association
Disclosure: Nothing to disclose.

CME Editor
Nicolas (Nick) G Slenkovich, MD, Director, Colorado Plastic Surgery Center
Nicolas (Nick) G Slenkovich, MD is a member of the following medical societies: American Academy of Otolaryngology-Head and Neck Surgery, American College of Surgeons, American Medical Association, American Society of Aesthetic Plastic Surgery, American Society of Plastic Surgeons, and Colorado Medical Society
Disclosure: Nothing to disclose.

Chief Editor
Deepak Narayan, MD, FRCS, Associate Professor of Surgery (Plastic), Yale University School of Medicine; Chief of Plastic Surgery, West Haven Veterans Affairs Medical Center
Deepak Narayan, MD, FRCS is a member of the following medical societies: American Association for the Advancement of Science, American College of Surgeons, American Medical Association, American Society of Maxillofacial Surgeons, American Society of Plastic Surgeons, Indian Medical Association, Plastic Surgery Research Council, Royal College of Surgeons of Edinburgh, and Royal College of Surgeons of England
Disclosure: Nothing to disclose.


Keywords: liposuction, trunk liposuction, upper body suction-assisted lipectomy, upper body contouring, body contouring, abdominal liposuction, suction-assisted lipectomy, SAL, ultrasound-assisted lipectomy, UAL, cross-tunneling, ultrasonic lipectomy, ultrasonic liposuction