Ultrasound-Assisted Liposuction

Current Concepts and Techniques

Onelio Garcia Jr.
Editor

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Editor
Onelio Garcia Jr.
Division of Plastic Surgery
University of Miami
Miller School of Medicine
Miami, FL
USA

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I have been very fortunate to have people in my life who believe in me and support my career. I wish to dedicate this book to them.

To my parents, Dr. and Mrs. Onelio Garcia Sr., who somehow envisioned that their 18-year-old surfer would attend college and then pursue a career in medicine.

To my children, Sloane, Alana, Brysen, and Spencer. They are my greatest source of pride. I have no doubt that they will all accomplish far more in their respective fields than I ever will in mine.

To my professor and mentor Dr. Bernard L. Kaye, a founding member and past president of the American Society for Aesthetic Plastic Surgery. Those of us who enjoyed the privilege of training under him learned far more than plastic surgery from a genuine "Renaissance Man."

To my contributing authors. Their contributions have greatly enhanced this book and I am extremely grateful for the time and commitment they invested in this project.

To my longtime associate Dr. Jose Perez-Gurri, a contributing author in this book. After a third of a century, I still find enjoyment in us working side by side and discussing the occasional interesting case. What an amazing experience it has been!

To Isabel who has defined for me unconditional love and devotion. I am so very grateful that you, for one, understand the demands of my career and support it.

To my patients. It has been my privilege to have been entrusted with your care.

Onelio Garcia Jr.

Preface

It has been over 20 years since Rohrich, Beran, and Kenkel wrote their acclaimed textbook, *Ultrasound-Assisted Liposuction*. The book served our specialty well. It was a comprehensive, concise reference which covered all the important topics associated with what was then a new and exciting technology for plastic surgeons.

Since that time, we have developed a better understanding of the dynamics of internal ultrasound for body contouring and its effect on adipose tissue. The current ultrasound devices for liposuction are safer and more efficient than the previous generations. This textbook is intended to bridge the gap between the early days of ultrasonic liposuction and the present. The contributing authors are all well-respected experts in the field who share their extensive experience with the new ultrasound technology. It is my sincere intention that this book will serve as a reference in ultrasound-assisted liposuction for years to come.

Miami, FL, USA — Onelio Garcia Jr.

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Contributors

Katherine H. Carruthers, MD, MS West Virginia University, Department of Surgery, Division of Plastic Surgery, Morgantown, WV, USA

Onelio Garcia Jr., MD Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

David E. Guarin, MD Universidad del Valle, Hospital Universitario del Valle, Department of Plastic Surgery, Cali, Valle del Cauca, Colombia

Alfredo E. Hoyos, MD Private Practice, Bogotá, Colombia

Clinica Dhara, Department of Plastic Surgery, Bogota, Colombia

Dennis J. Hurwitz, MD Hurwitz Center for Plastic Surgery, Pittsburgh, PA, USA

University of Pittsburgh, Pittsburgh, PA, USA

Mark L. Jewell, MD Oregon Health Science University and Private Practice, Portland, OR, USA

Carissa L. Patete, BS Miami, FL, USA

Pat Pazmino, MD University of Miami, Division of Plastic Surgery, Miami, FL, USA

MiamiAesthetic, Miami, FL, USA

Jose A. Perez-Gurri, MD, FACS Florida International University, Herbert Wertheim College of Medicine, Miami, FL, USA

Neal R. Reisman, MD, JD, FACS Baylor College of Medicine, CHI Baylor St. Luke's, Department of Plastic Surgery, Houston, TX, USA

Christopher J. Salgado, MD Miami, FL, USA

Mark E. Schafer, SB, MS, PhD Sonic Tech, Inc., Lower Gwynedd, PA, USA

Part I
Fundamentals

Chapter 1
Ultrasonic-Assisted Liposuction: Introduction and Historic Perspectives

Mark L. Jewell

It's 2019 and suction-assisted lipoplasty (SAL) has been around in America for almost 35 years. Without chronicling each advance in this technology, one can say that this has become a mature, yet integral surgical technology for thinning of subcutaneous adipose tissue (SAT). Lipoplasty has evolved into a sophisticated technique for 3D body contouring, harvesting of fat for grafting, and as a complimentary procedure with excisional body contouring (lipoabdominoplasty). I credit much of this to advances in technology over the years. On the other hand, there are many surgeons performing this procedure poorly with 30-year-old cannulas and no process to produce great results. Poor aesthetic outcomes continue to this day because some surgeons lack a process to produce great outcomes or have ill-defined subjective clinical endpoints during the procedure. Lipoplasty is not an all-comers procedure where poor decisions made in terms of patient selection produce poor aesthetic outcomes and patient dissatisfaction.

The concept of an energy-based lipoplasty device to enhance the ability of the surgeon to be more precise with the reduction of SAT or to modulate the midlamellar collagen matrix is perfect for ultrasonic energy versus other heat-emitting technologies (laser and radiofrequency). A variety of approaches have been tried, some very effective and others relegated to the medical device trash bin. Each of these has specific limitations and nuances. When choosing an energy-based lipoplasty device, the surgeon must surround himself/herself with a process to produce reproducible outcomes time and time again.

Cannulas that have some type of mechanical device to make them more (reciprocate or spin) are sold today. These are preferred by some surgeons for reduction of SAT or for fat grafting [1]. This family of devices requires rather high cost of disposable goods. The ergonomics of the device are poor, as it is somewhat large and difficult to be precise with a long power handle and cannula assembly. With power-

M. L. Jewell (✉)
Oregon Health Science University and Private Practice, Portland, OR, USA
e-mail: mjewell@teleport.com

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assisted lipoplasty, one is still performing SAL, but with a powered device. The same limitations for SAL apply here along with the need to be ultraprecise with technique when using a power tool. Personally, I never found this technology that appealing, due to poor ergonomics and cost of disposables.

The concept of using laser energy to heat SAT has largely come and gone. Few surgeons are using this technology currently. Laser-assisted lipoplasty (LAL) was heavily marketed to noncore physicians as a magic way to "melt fat." Unfortunately, this became a perfect storm of physicians lacking basic lipoplasty skills, an understanding of tissue thermodynamics regarding safe laser dosimetry, and improper selection of patients. The net outcome was tissue burns, contour irregularities, and fat necrosis. The laser energy frequencies typically target the chromophores of water and hemoglobin in tissues. With this comes heating of SAT to high temperatures and obliteration of blood supply. The net effect is inflammatory fat necrosis. Burns were an all too common adverse event associated with LAL. While marketing campaigns for LAL had catchy names like "Smart Lipo," there was little science or outcome data that validated the benefit of tissue heating with laser energy [2, 3]. LAL has become obsolete.

Radiofrequency-assisted lipoplasty (RFAL) has been around for a while, but has not achieved wide adoption. This is just another tissue heating technology that uses monopolar radiofrequency energy from a probe that is passed back and forth in the tissue. Initial reports on this device demonstrated very high tissue temperatures in the excess of 60C [4]. Later-generation devices incorporated temperature monitoring features designed to mitigate risk of skin and tissue necrosis. There have been reports of this device being used on arms to tighten tissue and in the female breast to produce tissue tightening via an "internal mastopexy." The equipment for RFAL does have a disposable cost and is challenging to use from an ergonomic perspective because of the tissue probe and accompanying return electrode.

Water-assisted liposuction that uses high-pressure fluid to disrupt adipocytes from the collagen matrix is a novel concept [5]. The major limitation here is the costs of disposable goods.

Ultrasonic-associated lipoplasty (UAL) has been around for a long time. There was a lot of interest in this technology in the late 1990s and subsequent disappointment with outcomes. The two major plastic surgery organizations in the USA under the leadership of Franklin DiSpaltro organized the Ultrasonic-Assisted Liposuction Task Force to help train plastic surgeons on how to operate second-generation UAL devices (Lysonix, McGhan Medical, Santa Barbara, CA; Wells Johnson, Tucson Arizona; and Mentor Contour Genesis, Mentor Corporation, Santa Barbara, CA). The task force offered didactic and bioskills training on the use of these devices. Before this time, there was not an educational pathway for plastic surgeons to become familiar with UAL.

In looking back, my analysis of what went wrong with traditional UAL involved several issues. First, the devices from that era were ultrasonic-powered cannulas that were inefficient as tissue fragmenters and aspirators. Second, surgeons did not have a process to safely use UAL devices or what was a safe amount of ultrasonic energy to apply (dosimetry). Most of the reported complications from early-generation UAL devices related to too much ultrasound or tissue burns from end of

the cannula touching the undersurface of the dermis ("end hits") [6]. In the late 1990s UAL fell out of favor with surgeons.

I became intrigued with UAL during this time as it seemed to have promise as a technique to improve the quality of lipoplasty but felt that given the inefficiency of the devices was a major problem. My introduction to the third-generation UAL devices called the VASER was approximately 17 years ago. Through William Cimino, PhD, my colleague, Peter Fodor, MD, and I were intrigued with a new approach for UAL with this device that was designed to overcome technical and functional limitations of the inefficient and dangerous UAL devices.

William Cimino, PhD, took a very analytical approach to UAL and why the first- and second-generation devices were not capable of delivering quality, safe outcomes. Surgical ultrasound-powered devices were nothing new, yet there were several things lacking in how UAL was performed and fat aspirated. First, fate fragmentation has to be accomplished with the least amount of energy (ultrasound), as excess ultrasound in tissues produces adverse events seen with second-generation UAL (burns, end hits, prolonged swelling, and seroma) that are the result of excess tissue heating. Second-generation UAL devices actually aspirated during fragmentation, thus removing the protective wetting solution that would mitigate tissue temperature elevation.

The VASER system was designed with small-diameter solid titanium probes with side grooving (Fig. 1.1). These would efficiently fragment fat at approximately

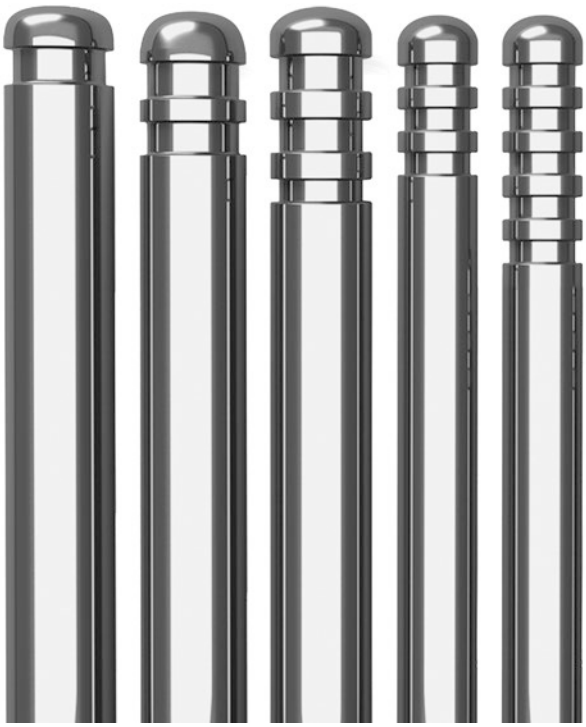

Fig. 1.1 The VASER system, designed with small-diameter solid titanium probes with side grooving

¼ of the energy that second-generation ultrasound-powered cannulas required [7]. The side grooving of the probe end dispersed the ultrasonic energy and reduced the risk of end hit burns. The ultrasound energy was applied in a pulsed fashion, enabling tissue fragmentation without excess heat. Continuous ultrasound was also possible, per surgeon preference.

The VASER system had a very precise fluid infiltration pump that could determine precisely to the cc how much wetting solution was infiltrated. This was useful, as the amount of ultrasonic energy applied with the VASER hand piece/probe was linked to volume of wetting solution infused, typically 1 minute of fragmentation time per 100 ml of infused wetting solution. This provided for efficient fragmentation of fat, minimal blood loss in the lipoaspirate, and avoidance of excess ultrasound (heat) in the tissues. The fluid infiltration system can be used for tumescent anesthesia for excisional body contouring or breast procedures.

Efficiency and precision in lipoaspiration was also addressed with the VASER system. For years, literally back to the onset of liposuction in the UA, most surgeons were using tri-port ("Mercedes-style") aspiration cannulas designed by Grams Medical, Costa Mesa, California USA. It was not unusual to see cannulas still in service that were over 20 years old. The problem with the traditional tri-port cannulas was inefficient aspiration due to a phenomena of "vacuum lock" where the ability of the cannula to efficiently aspirate declined as viscosity of aspirated fluid increased. This was overcome with a small air bleed into the vacuum line at the handle of the cannula. Additionally, Cimino and Fodor determined that cannulas with smaller side ports were more efficient for aspiration through exhaustive bench testing [8]. All VASER cannulas are equipped with a vented handle and are called "VENTX" cannulas. This technology is licensed to other SAL device manufacturers (Fig. 1.2).

Precision in the measurement of lipoaspiration was addressed with a canister system in the VASER device (Fig. 1.3). This was useful in helping the surgeon be more precise in the amount of lipoaspirate and avoidance of side-to-side variations in the same anatomic area, e.g., outer thighs. Precision in the determination of amount of lipoaspirate also is a safety issue where surgeons want to avoid excessive removal of fat in order to prevent contour defects or thinning.

I still recall in 1990 receiving my first VASER system that was intended to serve in a pilot study of the device that Dr. Fodor, Souza Pinto, and myself had agreed to perform. The system arrived without much instructions or directions for use. It was up to the three investigators to validate the principles of fragmentation time based on the amount of wetting solution infused and the utility of the vented cannula handle and canister system for measurement of lipoaspirate.

Fig. 1.2 "VENTX" cannula

Fig. 1.3 Precision in the measurement of lipoaspiration was addressed with a canister system in the VASER device

Much to our surprise, everything functioned perfectly. Fodor and Jewell utilized pulsed ultrasound ("VASER mode") and Souza Pinto used continuous ultrasound in his body contouring surgery. When the data was collected from the cases in our pilot study, we determined that there were none of the complications formerly reported with second-generation UAL devices and patient satisfaction was excellent. Results were published in The Aesthetic Journal and presented at ASAPS [6].

Subsequently, application of the VASER system has expanded into areas of 3D liposculpture (Hoyos and Millard), autologous fat harvesting into sterile canisters, and use in combination with excisional body contouring procedures (lipoabdominoplasty, Jewell) [9–11]. Depending on the size of probe used, VASER liposuction can be performed in conjunction with facial rejuvenation procedures. Credit must be given to Garcia for studying blood loss with VASER and conventional liposuction [12]. He

determined that in similar body locations, the blood loss was considerably less with the VASER.

The VASER system is the surviving UAL system that is in service today. It is versatile, cost-effective to use, and extremely durable. Advances in UAL technology enable patients to achieve reproducible clinical outcomes with the highest degree of patient satisfaction and lowest risk of adverse events attributable to the technology. The combination of technology, precision, finesse, and safety along with surgeon training/patient selection is the key to success with the VASER.

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Chapter 2
Basic Science of Ultrasound in Body Contouring

Mark E. Schafer

Background

Ultrasonic energy has been used for years in a wide array of medical applications – from dentistry to neurosurgery. The roots of ultrasound surgical devices can be traced back to the mid-1950s, with the development of ultrasound tools for dentistry [1]. It was found that ultrasonic vibration in the presence of sufficient fluid provided a simple effective treatment of dental calculus. The system reduced operator fatigue by eliminating the need for heavy scraping and improved the patient experience by reducing pain and bleeding.

This pattern of using ultrasonic vibration energy to reduce operator effort, with improved patient outcomes, has been repeated in a number of device designs since that time. Examples come from dentistry, neurology, ophthalmology, orthopedics, wound care, and nephrology [2]. Ultrasound aspiration devices have been used to successfully remove a range soft tissues such as skin, muscle, pathologic tissues (tumor), and fat. A key feature of ultrasound technology is that it can be "tissue selective," sparing connective tissues, nerves, and blood vessels. Further, ultrasound devices are designed to minimize heating, in order to reduce pain for the patient or damage to nearby tissues.

Progress has continued with the application of ultrasound technology specifically to body contouring, starting in the late 1980s and early 1990s. With first-generation ultrasound technology, ultrasound energy was applied in a continuous manner (to be explained further later in this chapter) via a 4–6 mm solid, blunt-tipped rod (or "probe"). This broke up fat deposits under the skin prior to removal under vacuum via a separate hollow cannula [3]. So-called second-generation systems switched to 5 mm hollow cannulae which permitted simultaneous fat

M. E. Schafer (✉)
Sonic Tech, Inc., Lower Gwynedd, PA, USA
e-mail: marks@sonictech.com

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fragmentation and aspiration. However, the aspiration efficiency was limited by the restricted 2 mm diameter inner lumen. Further, large access incision sizes of up to 1 cm were required to permit the use of relatively large instruments and skin protectors. There were a number of reports of poor clinical outcomes and surgical complications with these first- and second-generation devices, which limited their acceptance [4, 5].

In response to the shortcomings of traditional liposuction and prior energy-based technologies, researchers began developing a third generation of ultrasound-assisted liposuction system, called VASER (Vibration Amplification of Sound Energy at Resonance), in the late 1990s. The VASER system was designed to advance liposuction procedures by improving safety and efficiency; reducing physician fatigue; minimizing postoperative patient bruising, bleeding, and pain; and allowing for faster recovery [6].

This chapter will describe the basic science of ultrasound in body contouring, and specifically VASER technology, as well as a detailed explanation of the device design and mechanism of action.

Basic Ultrasound Terminology

A form of mechanical energy, sound is a vibration or pressure wave that travels through media. Sound travels in waves of higher and lower pressure. The high-pressure (compression) and low-pressure (rarefraction) regions alternate as the wave travels. Compression causes particles to be pushed closer together, while rarefraction pulls the particles away from one another. This causes the individual particles to vibrate back and forth in place. The amplitude of the wave equals the difference between the maximum values of compression and rarefraction (Fig. 2.1).

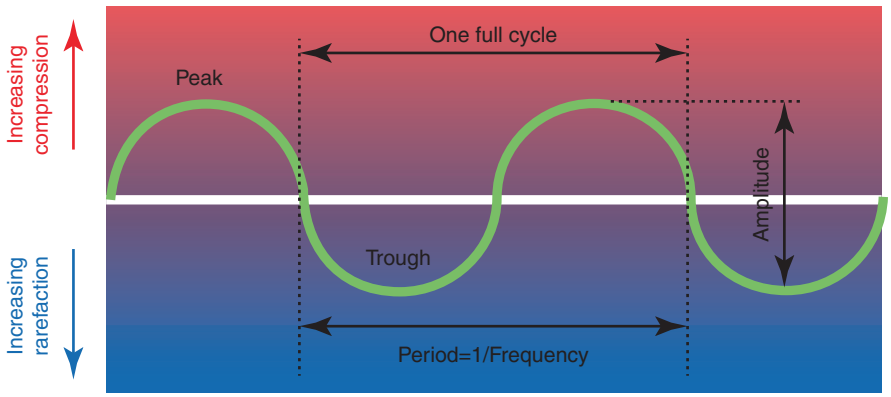

Fig. 2.1 Illustration of relationship between compressional and rarefactional wave components, including cycle period and frequency

The highest compression point is called the peak, while the lowest rarefaction point is called the trough.

Sound waves are characterized by their frequency: the number of times the pressure oscillates back and forth per second. Frequency is measured in Hertz (Hz), which is cycles per second. Ultrasound waves vibrate at frequencies greater than what can be detected by human hearing, which is about 18 kilohertz (18,000 Hertz) and higher. The period is the time required to complete one cycle. The period is the inverse of the frequency (cf Fig. 2.1).

Sound travels at a speed that is dependent upon the density and stiffness of the media it is traveling through. For most soft tissues, this speed is about 1.5 mm per microsecond. As the wave travels through a material, the wavelength is the distance corresponding to one cycle of the wave. Thus the wavelength varies directly with the speed of sound and inversely with the frequency. The higher the frequency, the shorter the wavelength and the closer the spacing of the peaks and troughs.

Other key concepts in ultrasonics are "continuous" and "pulsed" energy. Continuous, as the name implies, means that the ultrasound energy is on continuously, without interruption, as long as the foot pedal (or other control) is depressed. With pulsed (also labeled VASER mode), the ultrasound energy is rapidly switched on and off during operation (multiple times per second). The advantage of the pulsed setting is a lower overall average energy delivery and, thus, lower overall potential to create heat (see next section). It also reduces the heat generated within the ultrasonic motor inside the handpiece, which can affect operation and probe longevity.

System Components and Operational Characteristics

Components The key components of the ultrasonic surgical system are a generator or amplifier of electrical energy at a specific frequency, an ultrasonic motor which converts electrical energy into mechanical motion (comprising a piezoelectric transducer and back and front masses), a coupler or horn (mechanical wave amplifier) which conveys or amplifies the mechanical motion, and a probe which conducts the mechanical motion to the tissue (Fig. 2.2). There are, naturally, other components, such as a control mechanism (foot pedal, hand switch, knobs, user interface), a handpiece of some sort for the operator to grasp and manipulate the device, and a power supply.

As the electrical energy is applied, the handpiece transducer expands and contracts to create longitudinal compression waves in the probe. As the probe tip moves forward, it compresses the surrounding region. As the probe tip moves backward, rarefraction occurs. The forward and backward motion of the probe tip creates a spherically expanding wave of ultrasound energy, as shown in Fig. 2.3, with alternating compressional and rarefactional regions continually traveling outward in all directions (note that Fig. 2.3 is color coded to match Fig. 2.1). The tip excursion is

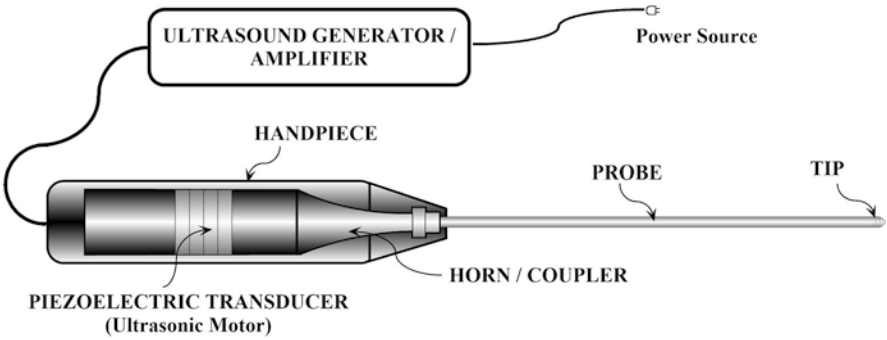

Fig. 2.2 Basic components of an ultrasound surgical system

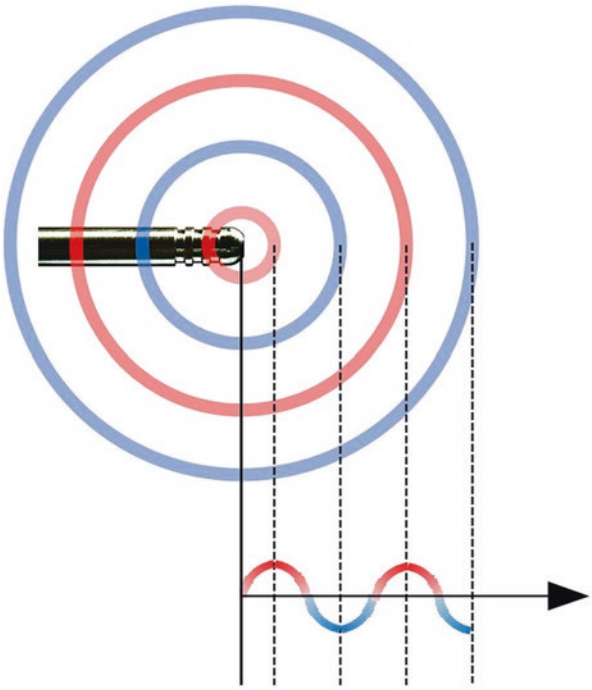

Fig. 2.3 Illustration of the spherical sound waves emanating from the probe tip. Colors representing compression and rarefaction match those in Fig. 2.1

typically about 75 microns and the amplitude of the acoustic field is directly related to this excursion. In other words, the greater the probe tip excursion, the greater the amplitude of the acoustic field. The tip excursion is controlled by the front panel setting.

Resonance A fundamental requirement of an ultrasonic surgical instrument is that it operate at or near a mechanical resonance, just as a bell will ring at a specific frequency when struck. Resonance enables the device to have maximum possible

excursion at the tip while requiring the minimum drive energy from the generator. Thus the entire structure is designed to maximize the desired resonant mode while minimizing the effects of any unwanted resonances. This is why handpieces and systems are "tuned" to operate at a specific frequency.

Standing Waves When the compressional waves travel down the probe, they are reflected back at the tip. The reflection pattern between the two waves produces a "standing wave" that causes specific regions of the probe to have nearly no motion (nodes) and other regions to have the highest motion (antinodes). The locations of minimum vibration excursion are also the locations of maximum stress, which are often the locations of mechanical failure due to metal fatigue. The tip is always an antinode and has the highest level of longitudinal (forward and backward) vibration. Since the tip is the main point of interaction with tissue, it is beneficial that it has the most motion.

The nodes and antinodes will shift in position as a function of sound speed in the probe material (a titanium alloy), and sound speed is temperature dependent. Thus the operational characteristics of the system may change as the device is used, which is why sometimes handpieces will stop operating after running for an extended period of time. If a handpiece becomes sufficiently warm, the resonance characteristic and node/antinode configuration can shift to the point that the amplifier/generator can no longer match the required frequency.

Frictional Heating The nodes and antinodes alternate along the probe shaft at intervals of one half wavelength. At an antinode location, the surface of the probe shaft is moving quite rapidly (equivalent to over 12 miles per hour) and thus there is the potential for frictional heating of anything that comes in contact with the probe shaft in those regions. This is the reason that skin protectors should be used and that the area around the skin entry point be kept moist and protected with wet towels. Frictional heating effects along the probe shaft are another reason that pulsed mode operation is typically preferred over continuous mode operation.

Mechanisms of Action

One of the most powerful aspects of ultrasound technology is that it can produce a wide range of clinical effects depending upon the choice of frequency, amplitude, mode of vibration, and probe design. The various mechanisms of action can be combined and/or tailored to meet specific clinical requirements. In the case of body contouring, cavitation and acoustic streaming are combined to create a safe, effective means of extracting adipocytes, with minimal effect on the surrounding tissue matrix.

Cavitation Cavitation is the term given to the action of gas bubbles in fluids; the science of cavitation is the subject of entire books (e.g., [7]). Cavitation is necessary

for efficient operation, and thus it is important to understand the different types of cavitation and how ultrasound can create, sustain, and destroy bubbles.

Cavitation Nuclei and Rectified Diffusion At atmospheric pressure and temperature, water will contain billions of microscopic air bubbles or cavitation nuclei. These are unavoidable, because air will diffuse into water until it reaches an equilibrium saturation point. Thus the tumescent solutions used during body contouring procedures contain dissolved gas (air) and cavitation nuclei. These microbubbles are in equilibrium with the gasses dissolved in the fluid, with gas continually diffusing into and out of the bubbles in equal amounts.

The sound waves emanating from the tip of the probe produce a push/pull force on the dispersed gas microbubbles. As the pressure wave pulls on the microbubbles, they expand, increasing their surface area and allowing additional gas dissolved in the fluid to enter by diffusion. The pressure wave next pushes on the bubble, compressing it and causing some of the gas in the bubble to diffuse back out. Since the bubble is smaller when compressed by the pressure wave, less gas diffuses out during compression than diffuses in when the bubble is under tension. Thus, with the passage of every ultrasound wave, there is an overall net increase in the volume of the gas bubble. This process is called rectified diffusion [8–10]. Figure 2.4 illustrates this process.

The bubbles rapidly expand from 5 to 10 microns to their resonant size, which is determined by the physical properties of the fluid (surface tension, viscosity, and

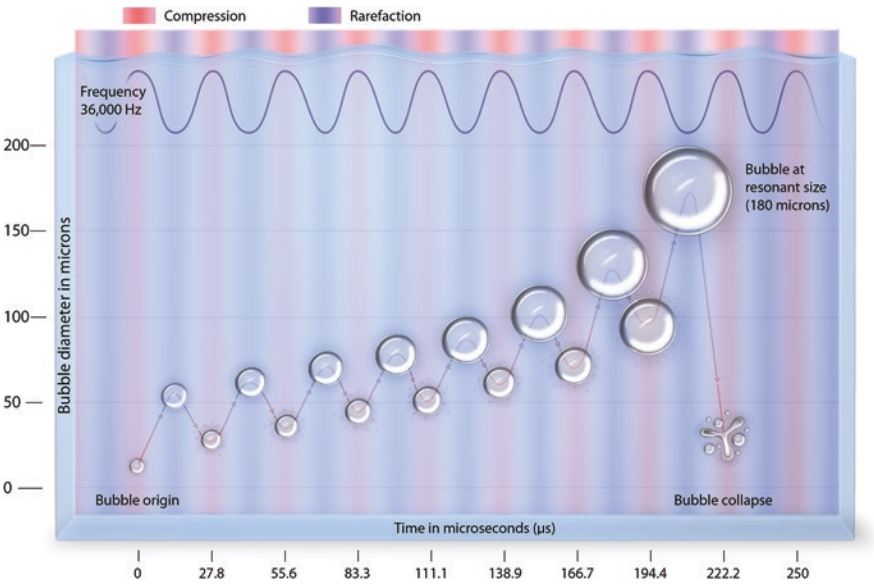

Fig. 2.4 Illustration of rectified diffusion. Under the influence of the ultrasound wave, bubbles grow until they reach resonant size, followed by collapse. (Illustration by Travis Vermilye)

density) and the frequency of the applied ultrasound. For a frequency of 36.6 kHz (the operational frequency of the VASER system), the resonant bubble size is approximately 180 microns. At resonance, the bubble expands and contracts vigorously with each ultrasound pressure fluctuation. At this point, there are two possible outcomes: either the bubble collapses violently or it breaks apart more gently. The former situation is called transient or inertial cavitation, and the latter is called stable cavitation.

Transient Cavitation In this case, the bubble collapses down into a very small volume, creating extremely high focal pressures and temperatures [11]. It is a very localized phenomenon, just in the immediate region of the probe tip, and has relatively minor effect on tissue. However, this is the mechanism by which the end of the probe becomes eroded with use. Figure 2.5 illustrates the effect on the probe tip, with evidence of pitting from transient cavitation bubble collapse.

Stable Cavitation The other fate of resonantly vibrating bubbles is that they simply break apart more gently rather than collapsing violently. In this case, the bubble fragments are then available to start the rectified diffusion process anew. One feature of stable cavitation is the large cyclic pulsations at resonance that cause large shear forces in the region around the bubble. These shear forces can dislodge cells from their tissue matrix, as will be discussed later in this chapter.

One of the most important things to understand about cavitation is that it is the action of ultrasound on gas bodies, whether cavitation nuclei or bubbles. Since the body's cells contain no free gas, only fluid, ultrasound energy cannot cavitate the cells themselves. Only the bubbles in the surrounding interstitial media can interact with the ultrasound waves to create cavitation effects. Further, since adipocytes are filled with higher viscosity fluids (lipids), they are particularly resistant to the action of the ultrasonic waves and to the possibility of cavitating.

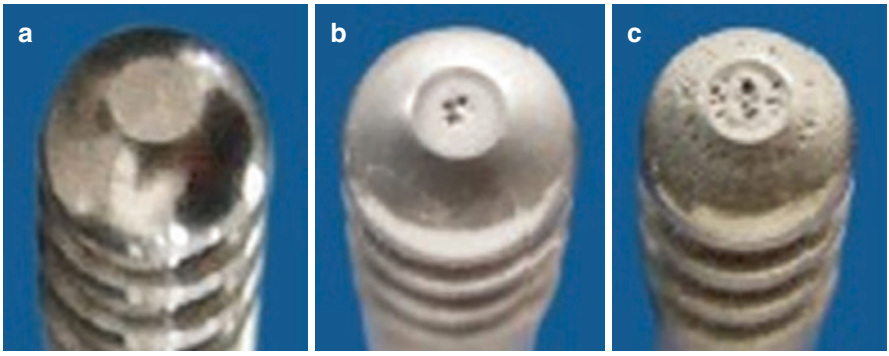

Fig. 2.5 Probe tips. (**a**) New probe, (**b**) probe with some pitting from transient cavitation bubble collapse, (**c**) probe with extensive cavitation damage

Acoustic Radiation Force and Streaming A propagating ultrasonic wave creates a net force on the medium through which it travels, called the acoustic radiation force [12, 13]. This force acting on fluids can produce a flow that is often called acoustic streaming. Additionally, the immediate volume around the end of the probe is subject to high shear forces as the probe tip moves back and forth within a fluid. These shear forces induce fluid flows [14], which, confusingly, have also been referred to as acoustic streaming. Figure 2.6 illustrates the effect of these forces around a probe tip. For this experiment, the tip was immersed in a small water chamber with transparent walls, partially filled with water. When the probe was energized, the water level in the chamber was forced up in the region where the probe entered the water. The streaming forces near the probe are shown by the arrows.

Acoustic Pressure and Power As described earlier, ultrasound energy is generated by the vibrational movement right at the tip. The acoustic pressure level from the probe can be expressed as a function of frequency, excursion, and cross-sectional area of the probe tip [15, 16]. Thus increasing the probe excursion (by increasing the output setting on the generator) increases the pressure output and therefore the various effects described above. Another way to change the pressure is to change the cross-sectional area, either by choosing a probe with a different diameter or one that has more "rings" (See Fig. 2.7). The rings create additional vibrating surface area and thus more acoustic output and more streaming and cavitation. However, the rings do not impart any particular directionality to the acoustic energy pattern from the tip: the general pattern of wave energy from the tip matches Fig. 2.3 irrespective of the number of rings.

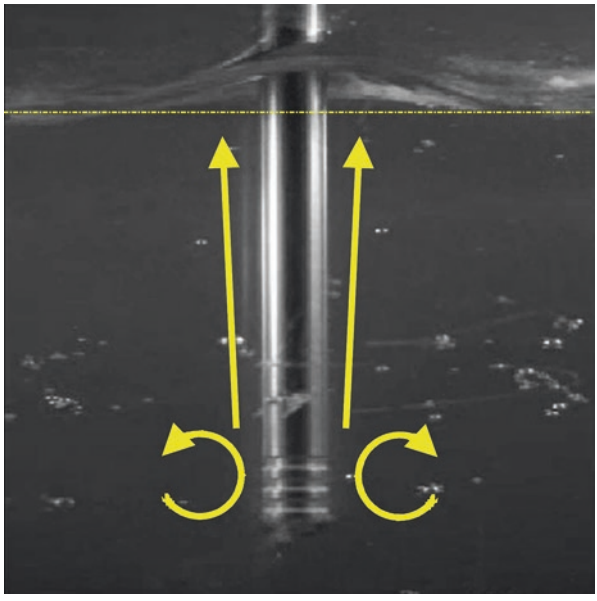

Fig. 2.6 Photograph showing acoustic streaming effects. Dotted line is water level with no ultrasound energy. Upon activation, acoustic streaming near the probe tip (circular arrows) produces a net flow of water toward the surface (straight arrows), raising the water level

Fig. 2.7 Photograph of various VASER probe tips, showing a range of diameters and number of rings. The diameter and number of rings affect the total acoustic energy delivered by the probe

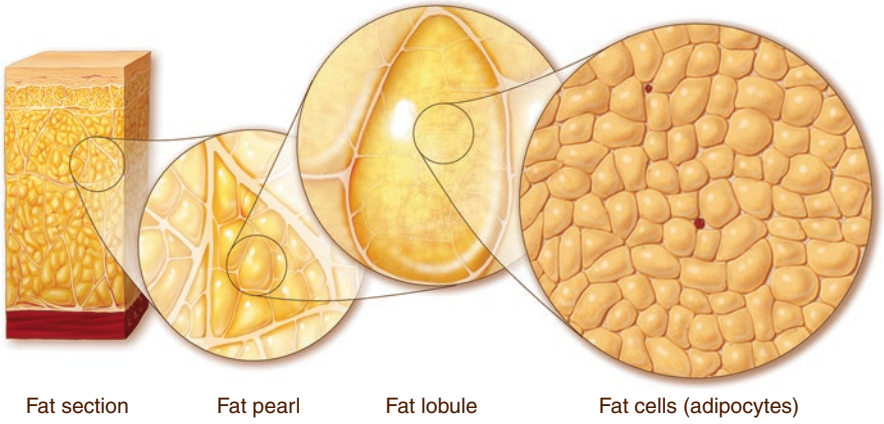

Fig. 2.8 Illustration of organization of fat within the body. (Illustration by Travis Vermilye)

Interaction of Ultrasound with Fat

Individual fat cells are contained within larger groups of cells that comprise fatty tissue. Fat cells are part of fat lobules, which are part of fat pearls, which are contained within fat sections, which are within fat compartments (Fig. 2.8). Since fat cells have the ability to change dramatically in size (from 20 to over 200 microns in diameter as a person gains weight), they are bound together relatively loosely compared to muscle, fascia, nerves, and blood vessel cells. Figure 2.9 is an illustration of fat cells in the vicinity of a small vessel. Note that while the fat cells are loosely

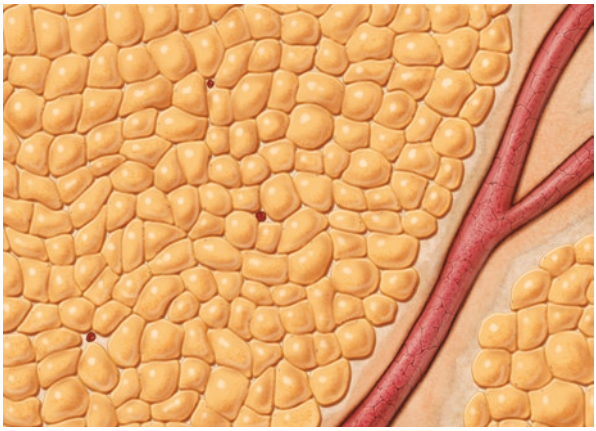

Fig. 2.9 Illustration of fat before infusion of tumescent fluid, including nearby blood vessel. (Illustration by Travis Vermilye)

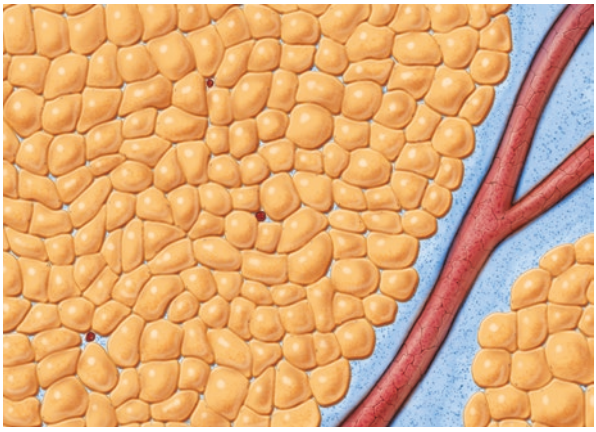

Fig. 2.10 Illustration of fat after infusion of tumescent fluid. Note that the fluid has infiltrated throughout the fat region, including between the fat cells. (Illustration by Travis Vermilye)

bound, the cells of the blood vessel wall have tight junctions (thus preventing leakage of blood into the interstitial medium).

During body contouring, tumescent fluid is infused throughout the targeted fatty tissue area. As noted earlier, the tumescent fluid naturally contains small gas bubbles on the order of 5–10 microns. As the fluid is infused, the microbubbles become dispersed throughout the tissue matrix. Due to the relatively loose packing of the fatty tissue, the tumescent fluid surrounds the fat cells, allowing the gas bubbles to infiltrate between individual cells. In contrast, the tight junctions between cells within blood vessel walls and connective tissues prevent gas bubbles from interspersing among and affecting these tissues (see Fig. 2.10).

When subjected to the ultrasound field from the probe tip, the bubbles grow by rectified diffusion to their resonant size, allowing the bubbles to act as wedges between the fat cells, dislodging the cells from the adipose matrix (Fig. 2.11). Once the bubbles reach their resonant size, they collapse, pulling on and further loosening the fat tissue matrix. The progression then starts over again.

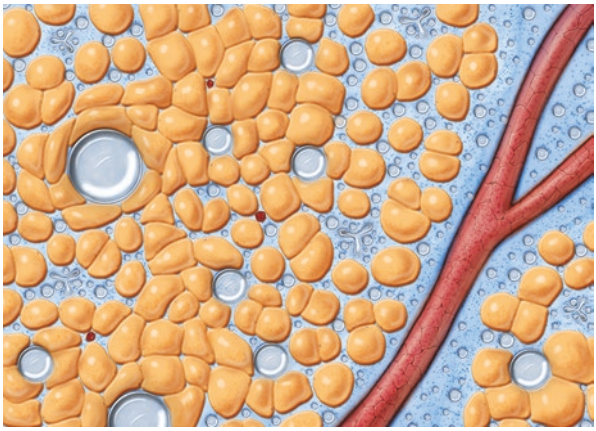

Fig. 2.11 Illustration of bubbles activated by ultrasound energy, expanding in the regions between the fat cells, thus loosening them from the tissue matrix. Because the bubbles cannot infiltrate between the tight cellular junctions of the blood vessel, it is not affected. (Illustration by Travis Vermilye)

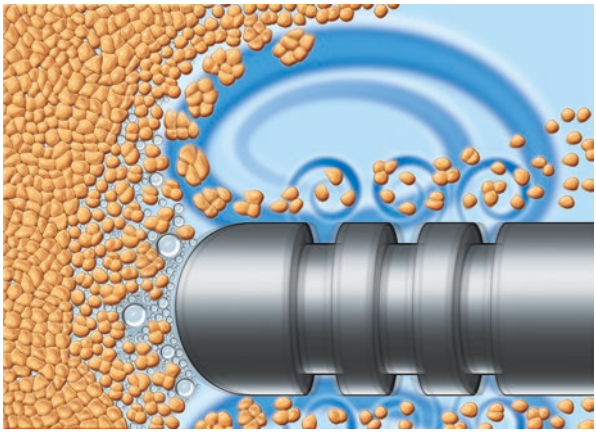

Fig. 2.12 Illustration of cavitation and acoustic streaming in the region of the probe tip. Acoustic streaming acts to dislodge and create a suspension of fat cells in the tumescent fluid, just as it did in Fig. 2.6. (Illustration by Travis Vermilye)

As the fat cells are displaced, they are mixed with the tumescent fluid by through acoustic streaming, resulting in a complete suspension of the fat cells, which are subsequently aspirated (Fig. 2.12).

Since adipose cells contain no gas, ultrasound energy does not cavitate adipose cells. Analysis of fat aspirated after ultrasound-assisted lipoaspiration (UAL) confirms that the technique does not cause widespread destruction of fat cells and release of lipids [17]. Also, since the bubbles cannot intersperse between the cells of blood vessels, nerves, and other similar tissues, the bubble-mediated cavitation action only acts to dislodge the adipose cells, leaving the other tissues unaffected. This natural tissue selectivity of VASER technology helps reduce patient blood loss during procedures and help maintain a healthy tissue environment post-surgery, speeding healing and minimizing patient discomfort.

Since individual fat cells remain intact, fat collected during the procedure may be harvested for autologous fat transfer [17, 18]. The strong acoustic streaming action refines the aspirated fat down to small lipocyte packets comprised of 2–3 fat cells,

which supports growth and vascularization upon reinjection. This is in contrast to the fat aspirated during other liposuction procedures, which may be harvested in large cell packets approximately 50 cells in diameter. These large cell clusters are associated with high rates of cell disruption from shear forces during reinjection and necrosis at the core after reimplantation due to inadequate blood supply. The VASER system utilizes acoustic forces to safely dislodge fat cells while protecting surrounding tissues, ultimately producing a clean, smooth aspirate with excellent cell viability.

Summary

Based on decades of ever-expanding clinical utility, third-generation ultrasonic liposuction systems for body contouring have evolved to be ideally suited to safe, effective treatment. The VASER® system combines a relatively high frequency (36.6 kHz), low excursion levels (below 75 microns), pulsed operation, and probe rings (to increase the effective area) to optimize ultrasound delivery. It exploits specific ultrasonic phenomena, namely, stable cavitation and acoustic streaming, to create a unique tool for the safe removal of fat from the surrounding tissue. It thus provides several benefits, including tissue specificity, limited blood loss and patient discomfort, smooth skin retraction, and preservation of fat cell viability for reconstructive or cosmetic purposes [17, 18].

Acknowledgement Figures 2.4, 2.8, 2.9, 2.10, 2.11, and 2.12 Illustration by Travis Vermilye

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Chapter 3
Choosing the Correct Candidate

Jose A. Perez-Gurri

Patient selection is key in achieving optimal results. Body mass index (BMI) ideally should not exceed more than 30%, generally healthy, underlying medical conditions well controlled and patient expectations realistic. Patients with localized fat are the best candidates (Fig. 3.1a–f). The patient needs to understand that body contouring surgery is not a means to an end but rather an adjunct to a change in lifestyle. Proper nutrition and regular exercise must be a part of their commitment. Oftentimes, patients will present with a BMI greater than 30 and must be approached and assessed individually. UAL (ultrasonic-assisted lipoplasty) has afforded patients that are heavier, an option to traditional suction-assisted lipoplasty (SAL).

An understated requirement is setting realistic expectations with the patient. Body image is unique and must be addressed as such by the surgeon. Oftentimes, the patient has viewed before and after photographs of patients who have undergone similar procedures. He or she may desire similar results without realizing that body frames and distribution of fat are very different than their own. It is the responsibility of the surgeon to assess whether or not what the patient's "wish" is realistic or not. Body dysmorphic disorder has gone under-recognized for years but today needs to be taken into consideration with all patients undergoing cosmetic surgery. It is estimated that 7–15% of cosmetic surgery patients are affected by this disorder [1]. Today, digital photography allows for patients to immediately view themselves on screen. This allows the surgeon to clearly communicate to the patient what the goals of surgery will be. In addition, the patient can opine on which areas are most concerning and objectively look at their image. There are software programs, such as TouchMD (Fig. 3.2), that allow the use of a touch screen (Fig. 3.1), thereby making it easier for the surgeon to detail the operative plan on the patient's image. Full-length mirrors may also be used. However, patients will frequently forget what has been pointed out.

J. A. Perez-Gurri (✉)
Florida International University, Herbert Wertheim College of Medicine, Miami, FL, USA
e-mail: jjogra@aol.com

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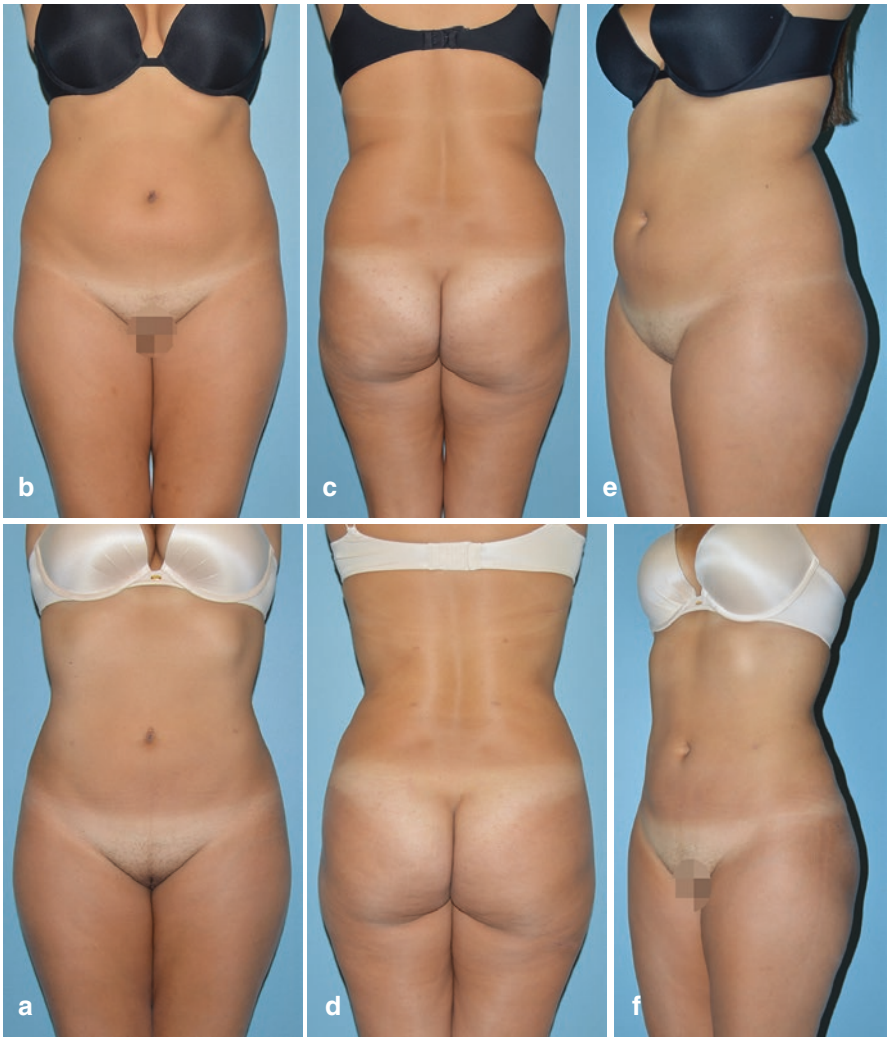

Fig. 3.1 Patient with BMI below 30%, good skin tone, and localized fatty deposits. (**a**) Front, after; (**b**) front, before; (**c**) back, before; (**d**) back, after; (**e**) oblique, before; (**f**) oblique, after

In summary, the best results are obtained in young healthy patients with a BMI of 30% or less, good skin tone, and localized areas of fat. Considerations such as age, skin elasticity, previous pregnancies, a history of weight loss and gain, and underlying medical conditions are key in patient selection. Older patients with a BMI greater than 30% and medical conditions such as diabetes and cardiopulmonary disease need to be evaluated in conjunction with their primary care physician, endocrinologist, and cardiologist. Underlying medical conditions do not necessarily preclude a patient from undergoing elective cosmetic surgery. The conditions, however, need to

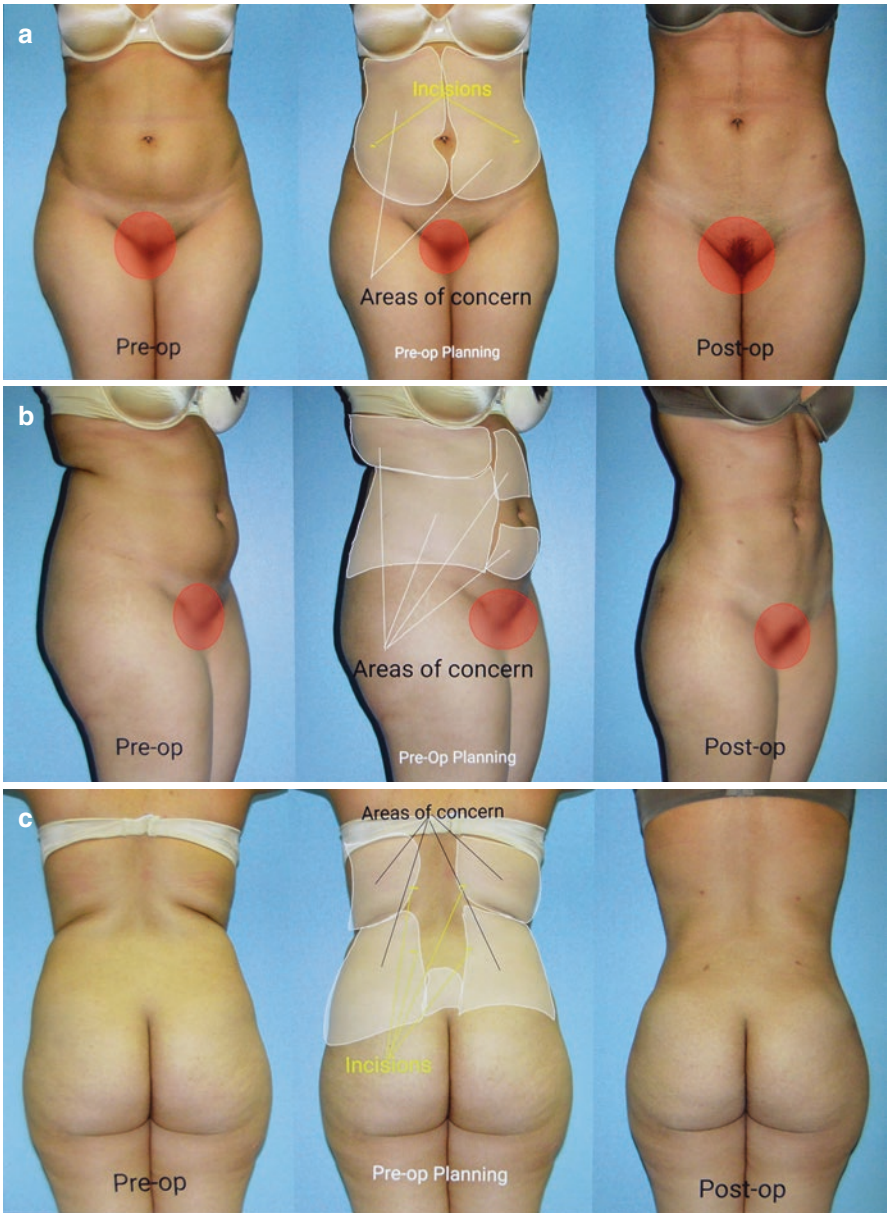

Fig. 3.2 TouchMD is a visual consultation, marketing, and imaging software utilizing touch screen technology that enhances the patient experience. (**a**) Front; (**b**) oblique; (**c**) back

be well controlled. The anesthesiology provider needs to be made aware of any medical conditions and given an opportunity to speak and interview the patient. All patients are at risk of developing pulmonary complications such as venous thromboembolism which are more prevalent in this population [2]. Diabetic patients need

tight control and ideally should have a glycohemoglobin (A1C) of 6.5% or less. Control of underlying medical conditions along with decrease in the use of tobacco products will reduce the incidence of postoperative complications [3, 4].

Patient Consultation

First impressions can be deceiving. Take your time in speaking with the patient. Listening is key. This initial assessment can be of great value to allow the surgeon to determine psychological and emotional suitability for cosmetic surgery. As with all elective cosmetic surgery, patients are making a decision which affects them emotionally, psychologically, and financially. They should be allotted sufficient time to express their concerns and goals. What is their emotional state? Goals? Did they bring "wish photos"? What is their demeanor? Have they researched the procedure? Have they researched the surgeon? In today's global information highway, there's little that a diligent patient can't find out. A well-informed patient is beneficial to the surgeon. Allow the patient to speak and don't be in a rush to explain the procedure and/or your credentials.

Following this initial conversation regarding their goals, likes, and dislikes, a thorough medical history is obtained. The cosmetic surgery patient, frequently, has had previous surgeries which may or may not affect the proposed procedure. Prior liposuction will definitely have an effect on the ultimate result. The patient is then asked to change into a gown. Although the initial conversation can be performed one on one, an assistant should be present during the physical exam portion of the consult. After having obtained written consent, digital photographs are taken of the areas of concern. Ideally, a touch screen should be used to clearly explain the operative plan, pointing out incision sites, favorable and non-favorable areas to be avoided, dimpling/cellulite, asymmetries, spine deformities such as scoliosis, and zones of adherences. Software programs such as TouchMD are very helpful in discussing areas of concern and proposed surgical plan (Fig. 3.2). In lieu of a touch screen, photographs should be used to point out the same. A written diagrammatic representation of this portion of the procedure should be stored in the patient's medical record whether digital or hard copy form. This documentation will limit postoperative patients from claiming that "it was never pointed out." Evaluation with a full-length mirror, although useful, should not replace the documentation on an actual photograph.

The Evaluation

Eventual results following liposuction are dependent on the surgeon's ability to understand the three-dimensional aspect of the subcutaneous fatty layer, zones of adherence, location on the body, skin tone and quality, existing scars asymmetries,

and cellulite. Subcutaneous fat is principally divided into deep, intermediate, and superficial compartments. This is particularly so in the abdomen where Scarpa's fascia is considered the structure dividing both. The deep fatty layer arises superficial to the investing fascia of the underlying muscle and is comprised of dense, large globules containing a network of partitions, whereas the superficial fatty layer is more dense and thinner and contains a network of organized septae [8]. These septae or connective tissue bands run from superficial to deep with attachment to the underlying fascia of the muscle. As the superficial plane becomes tethered by these bands, the zones of adherence are created. The superficial fatty layer becomes adherent to the underlying fascia. These areas, if not handled properly, can become a surgeon's nightmare by producing irregularities and contour deformities [9]. With few exceptions, the anatomical distribution of fat follows this pattern.

Liposuction is best carried out within the deep and intermediate fatty layers. The procedure carried out within these areas is very forgiving allowing for localized fat removal maintaining contour. Although forgiving, care must be taken in thinner patients because of the ease of introducing the cannula into the superficial layer. Liposuction within the superficial layer can be performed but the incidence of complications, contour irregularities, and possible tissue necrosis are higher than in the deep and intermediate areas.

The Information Highway and Informed Consent

With the use of the Internet and social media, most patients will be well versed on the procedure they desire and on the surgeon. Countless websites are exclusively dedicated to providing not only information on the procedures but reviews on surgeons [5, 10]. Social media platforms such as Facebook, Twitter, Snapchat, and the like are extensively used to investigate potential surgeons. By the time you meet the patient, they've had a chance to see your work and know your educational background, years of experience, professional complaints, and medical malpractice lawsuits and may even know the name of your favorite pet. A personal conversation serves to confirm what they already know about you or not. Patients are anxious and fearful of upcoming elective plastic surgery; be compassionate and understanding.

It is the responsibility of the surgeon to clearly articulate not just the proposed procedure but all risks and complications associated with it. A written record may be used and made part of the electronic record. The American Society for Aesthetic Plastic Surgery has information and consent forms available for the patient to sign (Fig. 3.3). These can serve as a template and be modified to reflect individual practices and patients' unique situation. Prior to patient signing, the office coordinator should read out loud to the patient and confirm that they understand. If the document contains multiple pages, we suggest that each page be initialed and then signed on the last page. The importance of a thorough, clear, and concise operative consent is often understated. The consent and procedure information form should reflect what has already been discussed by the surgeon.

Patient: Surgery Date:

CONSENT TO OPERATE

I hereby authorize_____ and such assistants as may be selected by him to perform and assist with the following operation:

LIPOSUCTION

I have been advised of other alternative methods of treatment for my condition, but I have requested the above-described procedure. It has been explained to me that no guarantee of results or warranty is given by the doctors and that there is a possibility of complications, which may arise from this procedure. The effect and nature of the operation to be performed, risks involved, as well as possible alternative methods of treatment, have been explained to me thoroughly.

The following complications have been described to me as a result of the type of surgery that I am going to have. None of them are common and some are very rare, but this is being outlined so I am fully aware of the important risks involved.

1. - BLEEDING: This is the most common complication of most surgical procedures and is the reason why we ask patients to stay off all aspirin-containing products for several weeks before surgery, avoid alcohol consumption completely for the same period of time, and be sure that your blood pressure is corrected to a normal level.

In spite of these precautions, bleeding can sometimes result in a hematoma, or collection of blood, which may need to be drained after the surgery. Any bleeding into the tissues causes discoloration, which prolongs the recuperation time. In rare cases, permanent discoloration may result.

2.- POOR WOUND HEALING: Patients who are cigarette smokers seem to have more trouble than non-smokers in healing wounds. There are also considerable variations between people's skin which can affect the way they heal, thus making it impossible to predict the final result of the scar with respect to color, size, or irregularities. In rare cases pigmentary changes have occurred.

3. - INFECTION: This can occur after any operation, even if all precautions are taken. In most types of surgery, giving antibiotics beforehand has not been shown to prevent infections. Infections and poor wound healing, if severe, may result in loss of tissue involved, therefore requiring future surgery at additional costs.

4. - PERSISTENT PAIN IN AND AROUND INCISIONS: Some patients will have pain or numbness in and around an incision for months and even years after surgery, and it is impossible to predict which patients will have this problem. Patients who heal with thick scars or keloids are more likely to have discomfort in the scar; but even a patient who has what appears to be a perfectly healed scar may complain of numbness or pain in and/or around the area.

5. - UNPREDICTABLE RESULTS: The results of any surgery are unpredictable for any individual patient, thus such a patient could have less than satisfactory result. Example: Dry and irritable eyes following eyelid surgery, unexplained pain, unpredictable distortion following breast surgery. In rare cases a satisfactory solution may not be possible. Additional surgery at additional costs may be necessary in order to attempt to correct the unpredictable results.

6. - IN ADDITION: Untoward results, which may arise specifically, related to the above mentioned procedure(s) include but are not limited to the following:
HYPERTROPHIC/KELOID SCARS, HYPERPIGMENTATION, PARTIAL OR FULL LOSS OF TISSUE, ALTERED SENSATION (INCREASED OR DECREASED), ASSYMETRIES, INFECTION, FAT NECROSIS, POSSIBLE INCREASE IN CELLULITE, SKIN IRREGULARITIES, CONTOUR DEFORMITIES, BURNS

Initials:_____

Some of these above-mentioned complications, if severe enough, might require further surgery in order to correct the complications, which followed the original surgery. This, of course, would prolong the recovery time and, if severe, may contribute to a poor result. Additional costs may be incurred. In addition certain medications are used before, during and after surgery, which could possibly cause an allergic reaction resulting in physical harm or even death. You should be sure to tell your doctor if you are allergic to any medications or have had difficulties in the past with any type of medication. If your medical status changes between the time of the original consultation and the date of your surgery, notify your surgeon.

I recognize that during the course of the operation unforeseen conditions may necessitate additional or different procedures than the one originally scheduled. I therefore authorize and request that the above-named physician, his assistants and/or his designees to perform such procedures as are, in their professional judgment, necessary and desirable for my best care. The authority granted under this paragraph shall extend to remedying conditions that are not known to the above-named physician at the time the operation is commenced.

I consent to the administration of anesthetics to be applied by or under the direction of the surgeon, and to the use of such anesthetics, as he may deem advisable in my case.

Fig. 3.3 Consent to operate

This consent is signed with full knowledge of its contents and is not revocable except prior to the procedure by written notice of revocation delivered to the authorized physician. I know that the practice of medicine and surgery is not an exact science and therefore reputable practioners cannot properly guarantee results. I acknowledge that no guarantee or assurance has been made by anyone regarding the operation, which I have herein requested and authorized

I have thoroughly read this consent and I understand its contents completely. The contents of this consent have been explained to me by _____and his staff. I am not under the influence of any substance and/or circumstance that could impair my judgment and decision-making.

_____ _____
Patient: Date:

_____
Witness

Fig. 3.3 (continued)

Digital Photographic Documentation

All patients need to have a photographic consent and release prior to a consultation and surgical procedure performed (Fig. 3.4). Photographs taken during the initial consultation will help the patient and surgeon achieve a better understanding of the end goals. The consent needs to be inclusive and all foreseeable circumstances taken into account. The consent should specifically grant permission to the surgeon, the corporate entity, assistants, photographers, and technicians to take photographs before, during, and after surgery (Fig. 3.1). Before and after photographs are frequently used for educational, advertising, and promotional purposes and the patient needs to be made aware. Patients may opt out of having their photos taken for the purposes mentioned above but they cannot refuse medical photography as part of their medical record. Never operate on a patient that refuses to have their photograph taken.

In today's digital era, photographs are used to market and advertise surgeons' practices. Often times, an exemplary postoperative result may be used for a number of years. Therefore, the consent and release must reflect this without placing a time limit to the use of the photo. Just like we save the digital images, consent and releases must be digitized and saved in the digital file of the patient. As we turn toward electronic medical records this should represent less of an issue. However, if the consents have been signed on paper and saved to the patient's hard copy record, digitizing is a must. Depending on where your practice is located, time limits exist after which medical records may be destroyed to allocate for more physical space within the office. A digital reproduction of the consent will prevent a patient coming back and claiming she never consented to her photographs being used. The patient should never be identified by name. However, more and more ink body art (tattoo) is being applied. The patient should agree that if her/his photo is used the consent allows permission identifiable marks. The consent should specifically address this issue. Should the patient choose otherwise, the consent can be edited to reflect the wishes of the patient.

Patient: Surgery Date:

PHOTOGRAPH CONSENT & RELEASE

I hereby authorize and grant (DOCTOR'S NAME), and/or (CORPORATE ENITY/PROFESSIONAL ASSOCIATION), and such assistants, photographers, technicians as they may engage in this purpose, to take photographs of me as they desire before, during, and after the operation. It is also understood that ink body art (tattoos) may be visible in such photographs.

Furthermore, I grant permission to (DOCTOR'S NAME) and/or (CORPORATE ENITY/PROFESSIONAL ASSOCIATION), the employees, agents, licensees, successors and assigns of each the absolute and unconditional right and permission to use or re-use, publish, broadcast and copyright any and all photographs of me which may be included in whole or in part, without restrictions as to time through any media for art, medical education, professional journals, medical books, medical conferences, advertising, promotional or any purpose whatsoever, in any and all media known or hereafter created, including Internet, throughout the world in perpetuity.

Authority is further given to permit the modification or re-touching of the aforementioned photographs, and the publication of information relating to my case either separately or in connection with the publications of the photographs taken of me.

Although I give permission to the publication of photographs concerning my case, it is specifically understood that I will not be identified by name.

_____ _____

Patient Date

_____

Witness

Fig. 3.4 Photographic consent

Although still in use, photography on film is rare and today digital photography is the standard. Plastic surgery is a visual specialty and therefore, photographic documentation needs to be standardized. These standards have long been established [6]. Since then, new surgical procedures have been introduced which may require additional views to accurately document but the basic principles apply. There are multiple considerations which must be taken into account when shooting clinical photographs in plastic surgery patients. Standard positioning and angles are key. Front, oblique, side, and back views are standard in most procedures. Facial procedures will require close-ups with a "worm's eye view" for rhinoplasty patients. Attention to focus, lighting, and absence of shadows need to be consistent. Before and after photographs should be superimposable on one another with the only difference being the postoperative changes. All it takes is a journey through plastic surgery websites to realize the inconsistency by surgeons to properly reproduce before and after results with a total disregard for standards that have long been established [7].

Attention needs to be paid to the type of camera used (SLR vs none-SLR), lighting setup, shutter speed, aperture, flash compensation, strobe (slave vs none),

photographic background color, and field of focus distance. Patients should be devoid of makeup and jewelry. However, if the patient has makeup and jewelry in the preoperative photograph, the same should hold true for the postoperative photograph. The end point should always be consistency and reproducible results.

A separate photographic studio within the office is ideal. Unfortunately, it isn't always practical. Most surgeons do not have the physical space to accommodate a separate designated area for photography. Therefore, judicious use of an exam room can serve this purpose. You need to make sure you have enough focal distance to use a 50 mm lens for facial photography and a 105 mm lens for the body. The proper use of background color is essential. A medium blue background will best highlight skin tones, whereas other colors will detract from the subject. Although shooting against a black background will diminish any shadows, it absorbs color. The subject may appear too pale.

We recommend choosing a particular wall and painting it a medium shade of blue or having a blue screen that can come down from the ceiling (Fig. 3.5). When building out an office, exam rooms should be rectangular so that the focal distance is maximized.

Fig. 3.5 Photographic background within the exam room

The Surgical Facility-Patient Safety

Most liposuction procedures can be performed as outpatient in an ambulatory surgical center (ASC) or an office-based surgical facility (OBSF). Patients undergoing large-volume liposuction should be admitted to a hospital for close fluid monitoring. With today's rising costs, performing cosmetic surgery at an ASC can become prohibitively expensive for the patient. Office-based surgical facilities offer the patients a cost-effective and safe environment. A recent prospective study of 129,007 patients undergoing a total of 183,914 aesthetic procedures performed at hospitals (26.7%), ASCs (31.8%), and office-based surgical facilities (15.9%) showed complication rates of 1.3%, 1.9%, and 2.4%, respectively [11].

Accreditation by one of the following, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), the Accreditation Association for Ambulatory Health Care (AAAHC), or the American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF), is highly recommended. These entities set very high standards to ensure maximum patient safety. As a shift has been made toward office-based surgical facilities, accrediting agencies have held them to hospital standards. Facilities are inspected at certain intervals to make sure compliance is being held. In addition to accreditation, it is highly suggested that a risk management company be retained. The goal of a risk manager is to assure compliance and file a report with the accrediting organization and state board overseeing these types of facilities.

Individual state's requirements for office-based surgical facilities may differ. Therefore, a thorough search should be performed prior to building out, purchasing, or renting the space. The Guidelines for Optimal Office-Based Surgery was developed by the American College of Surgeons [12]. Office-based surgical facilities are classified into class A, class B, and class C (Fig. 3.6). A class C facility allows for more options in the selection of aesthetic surgical procedures performed since general anesthesia can be administered.

Patients must be made to feel as comfortable as possible. Never underestimate the level of anxiety generated on the day of surgery. A recovery alcove (Fig. 3.7) can

Fig. 3.6 Classes of a surgical facility are defined as to the level of care rendered

Class A facility: Provides for minor surgical procedures performed under topical, local, or regional anesthesia without preoperative sedation. Excluded are intravenous, spinal, and epidural routes; these methods are appropriate for Class B and C facilities.

Class B facility: Provides for minor or major surgical procedures performed in conjunction with oral, parenteral, or intravenous sedation or under analgesic or dissociative drugs.

Class C facility: Provides for major surgical procedures that require general or regional block anesthesia and support of vital bodily functions.1

Fig. 3.7 PACU alcove

serve as a preoperative holding area and subsequent postoperative recovery room. It should be private and have enough room to allow a family member or friend to be with the patient until ready for the trip to the operating room or just prior to discharge. It should be equipped with a cardiac/blood pressure/respiration monitor, pulse oximeter, suction device, and oxygen source (Fig. 3.8).

Operating rooms should be spacious and meet the space requirements of the accrediting agency (Fig. 3.9). In most cases requirements by JCAHO, AAAASF, and AAAHC far exceed those of the individual state. The use of sequential compression devices (SCDs) is required. Tumescent fluids need to be warm (except with ultrasonic-assisted lipoplasty (UAL)). The use of a blanket/fluid warmer is advised. During the case the patient has to be kept warm. This can be accomplished through forced warm air or other devices (Fig. 3.10). Although controversy exists whether or not forced environmental warmed air devices are associated with a slightly higher incidence of post-op infections, their benefit in maintaining normothermia throughout the case is extremely beneficial and essential in the postanesthesia care unit (PACU) [13, 14].

Fig. 3.8 Essential PACU monitoring equipment to include blood pressure, heart and respiration rates, and EKG tracing. Suction and oxygen supply is essential

Fig. 3.9 AAAASF-accredited facility and operating room

Fig. 3.10 Forced warm air device

In summary, the ideal patient should be healthy with a BMI of less than 30%, good skin elasticity, no or minimal cellulite, and asymmetries. She or he needs to have realistic expectations. The surgeon should take time to listen to the patient and document in writing and photographs the areas of concern. Patient safety is of primary concern. The procedure(s) should be carried out in a hospital for large-volume liposuction whereas most can be performed as an outpatient. The ASC or office-based surgical facility should be accredited by AAAASF, AAAHC, or JCAHO.

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Chapter 4
Anesthesia and Wetting Solutions

Onelio Garcia Jr.

Liposuction was introduced to the United States over a third of a century ago. Since then it has become one of the most common surgical procedures performed by plastic surgeons in the USA, typically ranking first or second on the annual list of procedural statistics comprised by the American Society for Aesthetic Plastic Surgery (ASAPS). The society estimates that over 90% of plastic surgeons in the USA perform liposuction and over 280,000 cases were reported last year [1].

Since the early days of liposuction, a young, healthy patient, close to their ideal body weight, with good skin turgor and with localized fatty deposits was universally recognized as the ideal candidate for the procedure. Although this description still remains the ideal, ultrasound-assisted liposuction has enabled plastic surgeons to expand the patient selection criteria. As somewhat older, overweight patients undergo liposuction procedures, the preoperative evaluation and anesthetic considerations take on a greater importance.

Preoperative Considerations

As always, a detailed history and physical examination is of paramount importance in the preoperative evaluation of patients undergoing surgical procedures under general anesthesia. Young, healthy patients without a history of medical problems and

O. Garcia Jr. (✉)
Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

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who are not taking medications regularly present a low anesthetic risk and are only required to undergo basic surgical laboratory studies consisting of complete blood count, urine analysis, and pregnancy tests for females. Patients above 45 years of age should have a full medical clearance with EKG. Patients with a history of smoking, asthma, or other pulmonary diseases should have a recent chest X-ray prior to surgery. Chronic medical illnesses such as hypertension or diabetes are not a contraindication for liposuction so long as the condition is well controlled by medications. Liposuction patients undergoing high-volume extractions (greater than 5 liters) can experience significant fluid shifts and should include a metabolic panel as part of the workup.

Our preoperative protocol includes intravenous administration of prophylactic antibiotics, preferably a cephalosporin in patients without allergies. Versed 2 mg (midazolam) is administered intravenously in the holding area.

Some authors (mostly in the Dermatology literature) have published on the use of local anesthesia for these procedures [2–4]. They report increased efficiency with the fat extraction and a low complication rate. One must remember that when tumescent local anesthesia (TLA) was first proposed, its motivation was to find a means of performing the procedure on an outpatient basis since the majority of dermatologists in the United States were not able to perform inpatient liposuction because they lacked the necessary surgical privileges in hospitals to perform the procedure [5].

After 34 years of performing liposuction I have come to the conclusion that for the great majority of my cases, general anesthesia works best. Most of my cases are moderate to large-volume circumferential liposuctions. In these procedures, patients are placed in lateral decubitus and/or prone positions where an endotracheal tube with proper control of the airway is of paramount importance. Currently, general anesthesia is extremely safe and enhances patient comfort during a lengthy and intensive body contouring procedure.

Our anesthesiologists perform the intravenous induction with propofol in combination with fentanyl. The typical anesthetic agent employed is sevoflurane. It has been reported that one third of the patients undergoing liposuction procedures either alone or in combination with open procedures experience postoperative nausea and vomiting [6]. This figure is within the reported incidence of nausea and vomiting for all surgical patients undergoing general anesthesia, which ranges from 25% to 43%. For this reason, Zofran (ondansetron) 4–8 mg is administered intravenously 30 minutes before the end of the surgery.

Anesthesia interferes with the body's thermoregulatory system. Induction of anesthesia in an air-conditioned operating room can result in a decrease of almost 2°C in body temperature. The vasodilatory effects of general anesthesia result in a redistribution of heat from the core to the periphery causing an increase in cutaneous heat loss. Hypothermia in the 33°C to 36°C is commonly experienced by liposuction patients as a result of the effects of anesthesia, infiltration of the wetting

solutions, and the large body surface areas exposed during these procedures. It is generally accepted that preoperative warming of the patient may reduce the hypothermia associated with anesthesia induction. We employ a Bair Hugger (Arizant Inc., Eden Prairie, MN), before, during, and after the surgery. The intravenous fluids are warmed; however I recommend not warming the wetting solutions. Large amounts of warm wetting solution infiltrated into the subcutaneous space will initially increase vasodilation with rapid absorption of the lidocaine into the intravascular space. The thermal energy from the internal ultrasound warms the fluids so pre-warming is not advisable.

Intraoperative Positioning

In addition to the supine position, liposuction patients are frequently positioned in the prone and lateral decubitus positions on the operating room table. Positional injuries to peripheral nerves and pressure-related injuries can be avoided by proper positioning and padding of all pressure points.

Patients placed in the prone position for surgery require facial protection. This is accomplished by placing the face in a Gentle Touch Prone Positioning foam pillow (Mizuho OSI, Union City, CA) while keeping the head and spine in a neutral position. A foam hip roll is placed under the iliac crests and two longitudinal rolls extending from the axilla to the pelvis are placed under the patient. The knees are slightly flexed and protected by a pillow and foam supports are used on the ankles. The arms are extended on padded arm boards and the elbows are supported with foam pads (Fig. 4.1a, b). Protecting the breasts from the weight of an immobile patient effectively prevents the significant postoperative breast tenderness that is

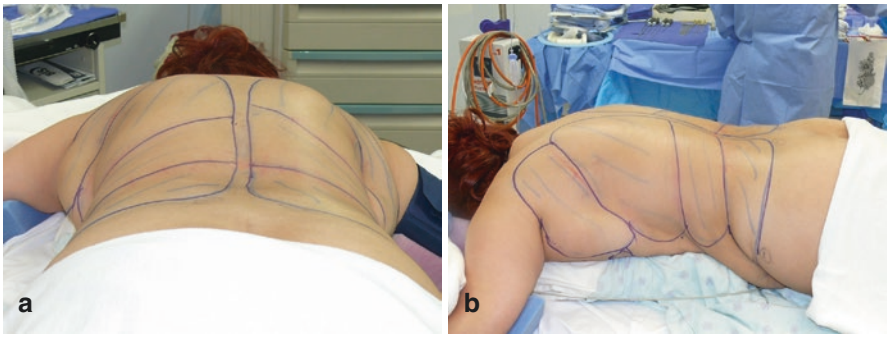

Fig. 4.1 The prone position. The arms are extended on padded arm boards (**a**), and the elbows are supported with foam pads (**b**)

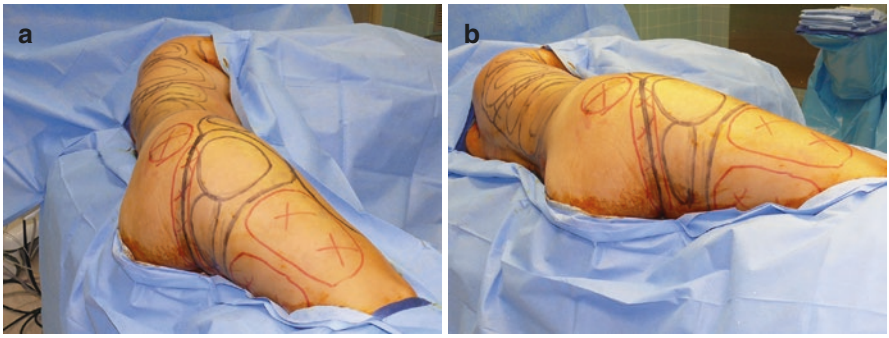

Fig. 4.2 The lateral decubitus position. The head is stabilized on a foam anesthesia headrest. The ankles are placed in foam protectors (**a**, **b**)

associated with prolonged pressure on the breasts. Avoid hyper-abduction of the arms since this places stress on the shoulder joint which could potentially result in brachial plexus injury. Pressure necrosis of the skin overlying bony prominences is always a concern in longer cases where the patient is immobilized in the same position for extended periods. Air, water, or gel mattresses are efficient in minimizing the load on these pressure points.

The lateral decubitus position is often used in circumferential liposuction patients. These patients are placed on a Bean Bag Surgical Positioner with a padded axillary roll and pillows in between the arms and in between the knees. The head is stabilized on a foam anesthesia headrest. The ankles are placed in foam protectors (Fig. 4.2a, b).

Since the initial anesthesia induction and intubation are performed with the patient in the supine position, all circumferential liposuction surgeries require turning the patient on the operating table. While the patient is being turned the anesthesiologist remains at the head of the table and is responsible for stabilizing the patient's head and securing the endotracheal tube. In our experience, turning most patients requires three other individuals in addition to the anesthesiologist. One assistant on each side and one at the feet of the patient who is also responsible for securing the Foley catheter during the turning process. Needless to say, this should all take place in a slow deliberate fashion in order to avoid significant alterations in the circulatory status which could result in hypotension.

Fluid Management

Our understanding of the effects of internal ultrasound on adipose tissue during liposuction procedures has significantly expanded over the past 20 years. The new generation devices such as VASER (Solta Medical, Bothell, WA) deliver significantly less ultrasound energy to the tissues than the earlier ultrasonic liposuction devices; however they perform more efficiently in a significantly wet environment.

VASER-assisted liposuction (VAL) requires high volumes of wetting solution infiltrated into the tissues and is thus associated with higher unquantifiable losses via the access incisions from the infiltrate back leaking under pressure. It was originally proposed that since only about 30% of the wetting solution infiltrate was aspirated in the liposuction aspirate, the other 70% would stay in the subcutaneous tissues and eventually be absorbed. My observation during numerous large VAL procedures is that close to a third of the infiltrate is lost through the access incisions both during the procedure and in the early postoperative period. That leaves only about a third of the wetting solution infiltrate behind that eventually gets absorbed. Most of my circumferential cases are moderate to high volume and our preference is to place an indwelling Foley catheter in these cases to monitor the urine output. Currently, the recommendations for VASER-assisted liposuction involve the infiltration of higher volumes of wetting solution which is why we recommend beginning the intravenous fluids at a rate of 2 ml/kg/hour. This rate is adjusted in accordance with maintaining a urine output of close to 1 ml/kg/hour. This protocol for fluid replacement has served us well in many hundreds of patients who have undergone higher-volume liposuction without experiencing fluid overload or hypovolemia. One must be careful when employing wetting solutions in higher volumes not to overload the patient. Gilliland and Coates [7] published on pulmonary edema complicating a tumescent liposuction. Although the early presumption was that the high-volume infiltrate resulted in the pulmonary edema, Pitman [8], in his discussion, attributed the complication to excessive parenteral fluids administered during the case. Typically, healthy individuals can tolerate high volumes of intravenous fluids (up to 2000 ml/h) since those fluids usually enter the extravascular tissues within 15 minutes. However when large volumes of tumescent infiltrate are present within the tissues, the hydrostatic pressure of that fluid in the subcutaneous space does not allow a gradient for the intravascular fluid to diffuse out of the vessels, another good reason to run the intravenous fluids at a very low rate during these surgeries and adjust accordingly with the vital signs and desired urine output.

Wetting Solutions

The French surgeons Illouz and Fournier are credited with being the first to employ a wetting solution infiltrate during liposuction [9]. During the latter part of the seventies decade they injected saline in minimal amounts (less than 300 ml) per liposuction case and reported a favorable effect on decreasing the bleeding associated with the procedure. In 1985, a dermatologist from California, Jeffrey Klein, began performing liposuction procedures using a tumescent local anesthesia formula. When Klein performed his first case, he used 35 mg/kg of bodyweight as the maximum dose for lidocaine. Since then other authors have published on formulas that employ higher total doses of lidocaine which exceed 50 mg/kg of bodyweight [10]. Even lidocaine that is administered within the accepted maximum limits may result in toxicity [11]. Factors such as cigarette smoking, oral contraceptives, obesity,

impaired renal function, impaired hepatic function, or cardiac disease can affect the protein binding of lidocaine. Certain medications such as tricyclic antidepressants, anorexiants, beta blockers, and histamine-2-blockers also affect the protein binding of lidocaine. Taking cytochrome p450 inhibitors may result in lidocaine toxicity even when the total dose of lidocaine administered is within the accepted safe range [12]. Absorption rates can vary significantly so the total amount of injected lidocaine sometimes is a poor predictor of the potential for toxicity. Peak plasma lidocaine levels have significantly better correlation with the potential for toxicity. The danger for higher-volume, tumescent liposuction outpatient procedures is that lidocaine absorption can peak 10–12 hours after infiltration, hours after these patients are typically discharged from the surgical facility [13, 14].

Since most of my liposuction surgeries are circumferential and moderate to high volume, my preference is general anesthesia. It not only improves patient comfort significantly but also provides a safe airway in the prone and lateral decubitus position. My preference for wetting solution in these cases is 1 mg of epinephrine 1:1000 in a liter of Ringer's lactate at room temperature. I do not use lidocaine for general anesthesia cases since its effect on postoperative pain is clinically irrelevant [15]. In the occasional small surface area case where general anesthesia is not utilized, 30 ml of 1% lidocaine is added to each liter of my standard wetting solution. Even though some proponents of local tumescent anesthesia for liposuction will disagree, I strongly believe that the total dose of lidocaine when used in wetting solution should not exceed 35 mg/kg of bodyweight. Peak plasma levels of lidocaine in the 3ug/ml are considered in the toxic range. Since most major circumferential liposuctions require general anesthesia, they do not need lidocaine as part of the wetting solution formula. Smaller liposuction procedures without general anesthesia do not require such high volumes of wetting solution, so there really is no good reason to push the limits of lidocaine toxicity in these patients undergoing elective, aesthetic surgery [16].

Epinephrine is an important component of wetting solutions for liposuction. The vasoconstrictive effects of this drug have significantly decreased the blood loss in the aspirate during liposuction cases. Common effects of toxicity include an increase in blood pressure, tachycardia, and arrhythmias. A total dose of 10 mg has been proposed by some authors [17]. The University of Texas Southwestern has reported administering up to 12 mg in some cases without associated complications. I have personally administered up to 14 mg in an intermittent fashion, throughout the course of a high-volume extraction case, without signs or symptoms associated with exceeding the toxic dose. It goes without saying that these patients require proper monitoring of their vital signs during the surgery. It is important to note the importance of infiltrating the wetting solution at room temperature. Warm wetting solutions are associated with initial vasodilation with early rapid absorption of the lidocaine component. If there are concerns about hypothermia, the intravenous fluids can be warmed in conjunction with warmed forced air via a Bair Hugger. The common wetting solution formulas are depicted in Table 4.1.

Pulmonary emboli should always be a concern for patients undergoing body contouring surgery. Although liposuction patients are typically relatively young and

Table 4.1 Common wetting solutions for liposuction

Garcia's formula	**Fodor's formula**
Ringer's lactate solution 1 liter (room temperature (21°C)	Ringer's lactate solution 1 liter Small volume (<2000 ml)
Epinephrine 1:1000, 1 ml	Epinephrine 1:500, 1 ml
For local anesthesia cases	Moderate (2000–4000 ml)
Add 30 ml of lidocaine 1%	Epinephrine 1:1000, 1 ml
Total lidocaine dose not exceed 35 mg/kg of bodyweight Large volume (>4000 ml)	Epinephrine 1:1500, 1 ml
Klein's formula	**Hunstad's formula**
Normal saline 1 liter	Ringer's lactate solution 1 liter
Lidocaine 1%, 50 ml	(38°C–40°C)
Epinephrine 1:1000, 1 ml Lidocaine 1%, 50 ml	
Sodium bicarbonate 8.4%, 12.5 ml	Epinephrine 1:1000 1 ml
Hamburg formula	**University of Texas**
Normal saline solution 1 liter	**Southwestern formula**
Lidocaine 2%, 10 ml	Ringer's lactate solution 1 liter (room temperature, 21°C)
Prilocaine 2%, 10 ml	
Sodium bicarbonate 8.4%, 6 ml	Epinephrine 1:1000 1 ml
Epinephrine 1:1000, 0.7 ml (>5000 ml) lidocaine 1%, 15 ml	

Room temperature is used for all formulas except the Hunstad's formula which warms the solution. The University of Texas Southwestern formula specifically defines room temperature as 21°C (70°F). In the authors' formula (Garcia's formula), I specifically mention room temperature to highlight the importance of not warming the tumescent fluid for ultrasound-assisted liposuction cases

healthy, risk factors that could potentially lead to deep vein thrombosis (DVT) and pulmonary emboli (PE) should be closely examined. Obesity, oral contraceptives, age over 40, history of malignancy, prior history of DVT or PE, and surgical times over 30 minutes are all predisposing factors. Deep vein thrombosis (DVT) appears as a tenderness in the calf region exacerbated by exercise. There may be tenderness to palpation and increased temperature of the surrounding skin. Increased resistance or pain to dorsiflexion of the foot (Homan's sign) is frequently present. Pulmonary emboli (PE) is usually associated with tachypnea, dyspnea, sudden pleuritic chest pain, and sudden apprehension. This can advance to findings of cor pulmonale and systemic hypotension. Early diagnosis is the key to successful treatment so postoperative patients exhibiting these symptoms need to be monitored and treated. Although a ventilation-perfusion scan can confirm the diagnosis, intravenous heparin may need to be started prior to obtaining the definitive diagnostic studies. Teimurian and Rogers [18] reported an incidence of DVT of approximately 33/100,000 and PE of approximately 12/100,000 in a survey of over 75,000 liposuctions. In another survey of members of the American Society for Aesthetic Plastic

Surgery, Grazer and de Jong [19] reported a mortality rate of 19/100,000 for liposuction patients, with approximately 25% of the deaths attributed to PE. My experience has been similar to the University of Texas Southwestern experience that the proper use of intermittent, pneumatic compression boots coupled with early ambulation is associated with virtually zero DVT-related complications following liposuction procedures. Most surgeons do not use pharmacological DVT prophylaxis for routine liposuction procedures because of the complications related to excessive bleeding and bruising. Surgeons should consider prophylaxis with low molecular weight heparin (LMWH) in patients undergoing major open procedures in conjunction with liposuction.

Conclusions

Liposuction procedures, particularly high-volume extractions, present distinct challenges for the anesthesiologist. There is the potential for hypothermia, hypovolemia, fluid overload, and toxic effects from lidocaine and epinephrine. Position changes on the operating table can lead to postoperative sequelae of pressure-related injuries. Of particular concern is the fact that peak plasma lidocaine levels can take 10–12 hours after infiltration, so toxicity may not manifest itself until hours after the patient has been discharged from the outpatient surgery facility. For these reasons an experienced anesthesiologist is preferred for the high-volume cases where large amounts of wetting solution are employed. Strict adherence to fluid replacement guidelines, close attention to patient positioning with proper padding of all pressure points, and not exceeding the total recommended doses for both lidocaine and epinephrine will help avoid serious complications.

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Part II
Clinical Applications

Chapter 5
Neck and Facial Contouring

Onelio Garcia Jr.

Preoperative Considerations

Patient selection is of paramount importance in achieving successful aesthetic results with neck contouring. One should never trade fat for loose skin, particularly in a visible area like the neck. An accurate assessment of skin elasticity is mandatory, particularly in older patients or those with significant amounts of submental fat. Some patients with extensive submental fat may need to accept a secondary open procedure if prominent platysma bands are exposed following the neck defatting. Although complications are rare with this procedure, the informed consent for neck contouring with ultrasonic liposuction should include the possibility of postoperative contour deformities, asymmetry, prolonged edema, exposed platysma bands, thermal injury, pigmentation changes, neck skin paresthesia, and vascular injury.

As with all other liposuction procedures, patients need to discontinue medications that interfere with coagulation (including over-the-counter products containing ASA or nonsteroidal anti-inflammatories) well in advance of their surgery date. All comorbid conditions such as hypertension or diabetes need to be under control prior to surgery and a full preoperative medical clearance is obtained in patients over 50 years of age.

The evaluation should include presence of scars, history of previous neck and or facial surgery, presence of platysma bands, assessment of submental fat (preplatysmal vs sub-platysmal), thyroid enlargement, parotid enlargements or masses, assessment of the jowls, submandibular gland enlargement, and any neck range of motion limitations. Of paramount importance is an assessment of how much fat volume extraction the skin elasticity of the neck will tolerate without losing its current skin tone. This is the one preoperative evaluation that takes significant

O. Garcia Jr. (✉)
Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

O. Garcia Jr. (ed.), *Ultrasound-Assisted Liposuction*,
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experience performing body contouring with liposuction to perfect so for the surgeon inexperienced with these cases it is best to err on the conservative side. A secondary surgery to remove some residual submental fat is a relatively simple procedure, whereas correction of a flaccid neck secondary to overextraction of submental fat is a more complex open procedure which the patient may not readily accept.

Standard photography is similar to that used for facial rejuvenation procedures. Photographic assessment should include a full-face and neck frontal view, 90 degrees from each side and 45 degrees from each side (Fig. 5.1a–e). Typical preoperative markings are performed with the patient standing or sitting upright and looking straight ahead. It is useful during the preoperative markings to note the location of the Jugular veins and also mark their location (Fig. 5.2a, b).

The instrumentation used for neck and facial VAL is highly precise. The probes and cannulas are much smaller than those employed in body contouring, typically 2.4 mm in diameter (Fig. 5.3). Occasionally 3 mm cannulas are employed for larger submental extractions; however diameters greater than 3 mm are not recommended in the face and neck areas.

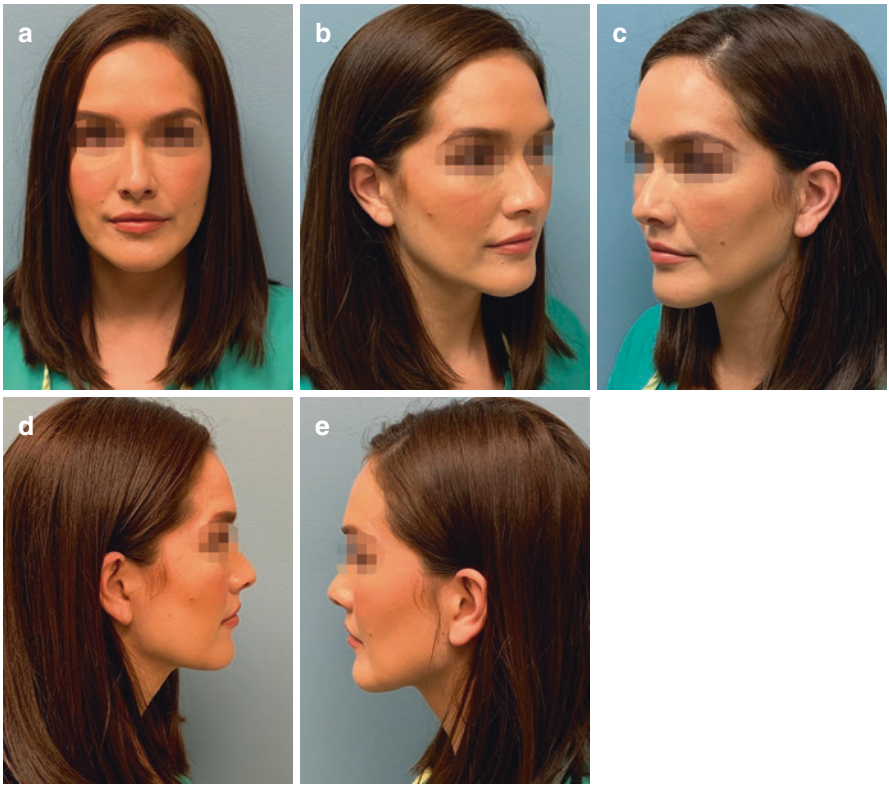

Fig. 5.1 Five standard preoperative photos for face and neck contouring. Full face and neck (**a**) front view, (**b**) right and (**c**) left oblique views, and (**d**) right and (**e**) left lateral view

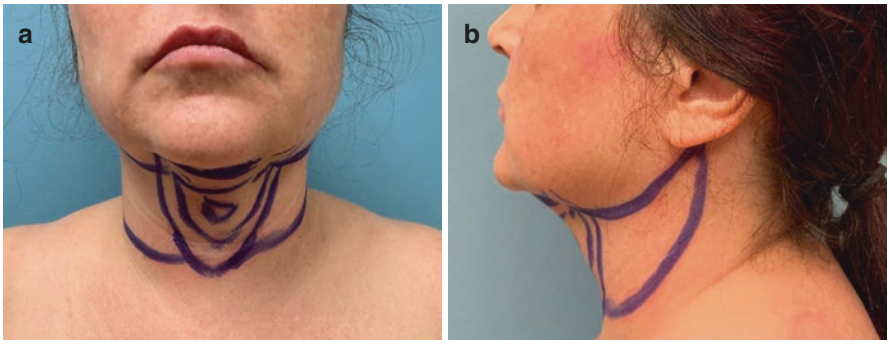

Fig. 5.2 Standard preoperative markings for neck contouring. (**a**) Front view, (**b**) lateral view

Fig. 5.3 Special face and neck instrumentation for VAL

Surgical Technique

Typically three access incisions are used for neck and facial contouring, one behind each earlobe and one in the submental crease (Fig. 5.4). This type of access avoids placing torque on the ultrasound probes and provides good access to the entire neck. It is important to treat the whole surface area of the neck below the mandibular border in order to achieve better skin retraction. Involving the whole neck in the

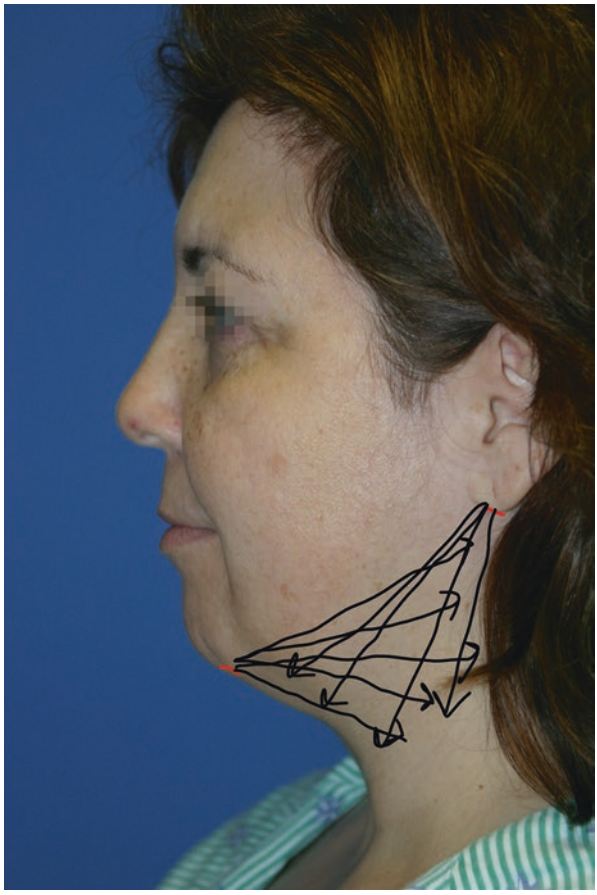

Fig. 5.4 Access incisions are marked; red and black arrows denote the path for the ultrasound probes and the aspiration cannulas

contouring yields a more harmonious result than spot suctioning. This is particularly important in cases that involve higher-volume submental extractions.

My standard wetting solution (Garcia's formula) [2] is modified for neck and facial contouring. When using general anesthesia, the formula consists of 1 L of lactated Ringer's solution at room temperature, defined as 21°C (70°F), plus 2 ml of epinephrine 1:1000. This is double the concentration of epinephrine recommended for body contouring procedures where the wetting solution is dispersed in larger volumes over a large surface area. Obtaining good tumescence in a relatively small surface area such as the neck requires much less fluid and in the author's experience the higher concentration of epinephrine results in highly efficient vasoconstriction in the area which results in minimal postoperative bruising. For intravenous sedation and local procedures, 50 ml of 1% Xylocaine is added to the wetting solution. Infusion rates are 150 ml/minute for local procedures and 200–250 ml/minute for general anesthesia procedures. This is the rare surgical procedure where local anesthesia may not be the safest alternative. It is the author's preference to

perform large-volume submental liposuctions under general anesthesia. The large amounts of fluids that are infused into the neck tissues to create tumescence may lead to airway complications in patients under intravenous sedation.

Contouring of the neck and submental area by means of VAL is a safe and efficient technique which yields highly aesthetic results. The patient satisfaction rate is high. It is associated with a low complication rate when performed using the recommended parameters for both the ultrasound energy settings and the time interval that the tissues are exposed to the ultrasound energy [3, 4]. A significant advantage of VAL for contouring the neck is less postoperative bruising, resulting in decreased downtime for the patient. The ultrasound-assisted liposuction techniques are associated with less blood in the aspirate when compared to traditional liposuction [5, 6], which translates to decreased postoperative ecchymosis. For a typical neck contouring procedure the author uses a 2.4 mm three-ring or five-ring VASER probe (Solta Medical, Bothell, WA) at 50–60% energy levels in pulsed (VASER) mode for approximately 3 minutes. Aspiration is performed with 2.4 and 3 mm VentX cannulas (Solta Medical, Bothell, WA). Although the approach to neck and submental contouring is similar for most patients, there are some variations in the extent of the surface area treated and the ultrasound exposure time, based on the approximate volume to be removed and the preoperative skin tone.

Postoperatively TopiFoam is contoured to precisely fit the area treated and a commercially available head and neck compression garment is applied (Fig. 5.5). Patients are asked to maintain head elevation for several days, avoid high sodium intake, and avoid strenuous physical activity. Moisturizing massages are begun several days after surgery, as tolerated.

Fig. 5.5 (**a**, **b**) Typical face and neck compression garment

Surgical Outcomes

A 35-year-old woman is seen in consultation requesting improvement of her neck contour. She is within her ideal body weight and denies history of significant weight loss. Her exam revealed moderate submental lipodystrophy with relatively good skin tone. VAL of the submental area extending into the lateral neck was recommended. Extending both, the VASER exposure field and the superficial liposuction over a greater surface area aids in skin retraction. The outpatient surgery was performed under intravenous sedation and local anesthesia. Three access incisions were used, retro-auricular on both sides and submental. The author's wetting solution formula for local cases consisting of 1 mg of epinephrine 1:1000 and 50 ml of 1% Xylocaine in a liter of Ringer's lactate solution was infused at the rate of 200 ml per minute. A total of 200 ml of the solution was evenly dispersed throughout the neck. A 2.4 mm, three-ring VASER probe at 60% energy level was utilized for 1 minute and 30 seconds in pulsed mode. Aspiration was performed with a 3 mm VentX cannula. Most of the treatment involved the submental area with minimal extension into the lateral neck. The aspirate volume totaled 60 ml. The access incisions were closed with a buried absorbable monofilament 4–0 suture and a facial compression garment over contoured TopiFoam was applied. Surgical results at 4 months are depicted in Fig. 5.6a–d.

A 38-year-old woman was seen in consultation requesting improvement in her neck contour. She has moderate lipodystrophy superficial to the platysma assessed by the pinch test. A VAL of the neck and submental area was recommended. The outpatient surgery was performed under intravenous sedation and local anesthesia. Retro-auricular and submental incisions were used for access. The author's recommended wetting solution formula for local cases was infused at 200 ml per minute to a total volume of 250 ml. A 2.4 mm, five-ring VASER probe at 60% energy level was utilized for 2 minutes in pulsed mode. Aspiration was accomplished with a 3.0 mm VentX cannula. Incisions were closed with buried absorbable sutures. A facial compression garment over a shaped TopiFoam sheet was applied immediately following the procedure. A total aspirate volume of 72 ml was extracted. Surgical results at 5 months are depicted in Fig. 5.7a–d.

A 30-year-old male is seen in consultation regarding the contour of his neck. He has an athletic physique and is well within his ideal body. Exam revealed mild submental lipodystrophy with good skin tone. A VAL of the neck and submental area was recommended. The outpatient surgery was performed under general anesthesia. Retro-auricular and submental incisions were used for access. The author's wetting solution formula for general anesthesia cases consisting of 1 mg of epinephrine in 1 L of Ringer's lactate was infused at 250 ml per minute. A 2.4 mm, five-ring VASER probe at 60% energy level was used in pulsed mode for 2 minutes. The liposuction component of the surgery was performed with a 3 mm VentX cannula, extracting a total volume of 70 ml. Incisions were closed with buried absorbable sutures and a compression garment over a contoured TopiFoam sheet was applied at the end of the procedure. Surgical results at 4 months are depicted in Fig. 5.8a–d.

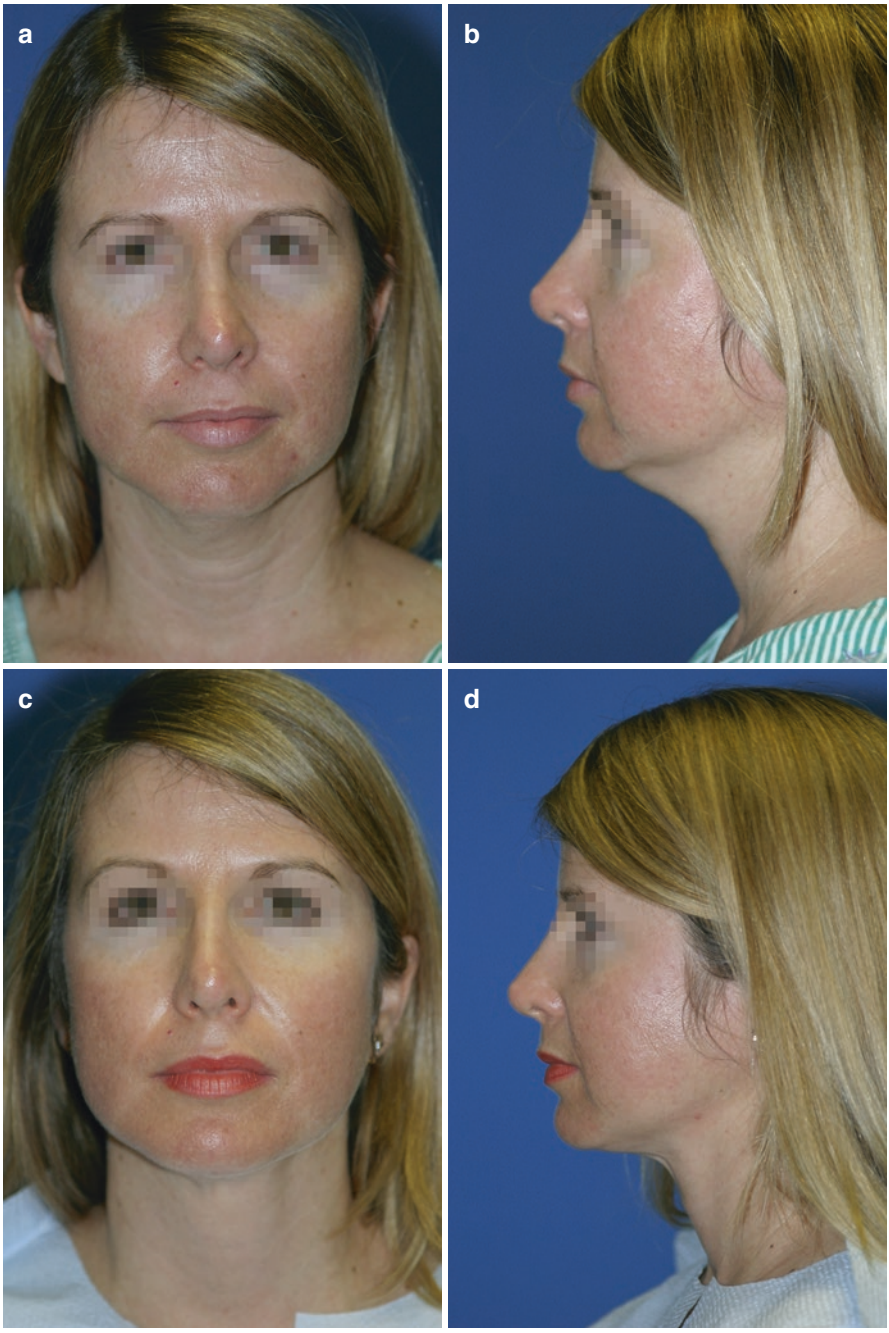

Fig. 5.6 A 35-year-old female patient with minimal submental lipodystrophy underwent VASER-assisted liposuction of the submental area and neck. Preoperative appearance (**a**, **b**). Postoperative appearance at 3 months (**c**, **d**)

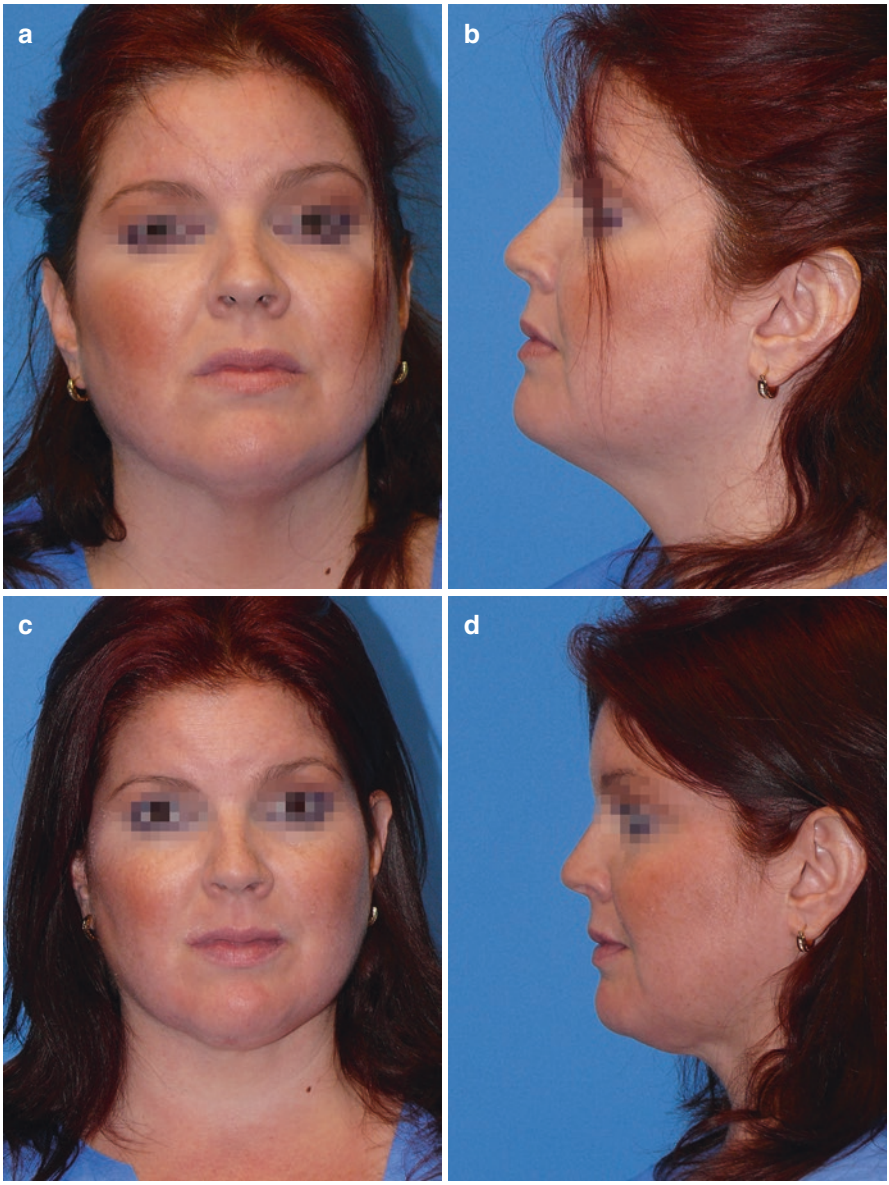

Fig. 5.7 A 44-year-old female patient with moderate submental lipodystrophy underwent VASER-assisted liposuction of the submental area and neck. Preoperative appearance (**a**, **b**). Postoperative appearance at 5 months (**c**, **d**)

A 44-year-old woman is seen in consultation regarding significant submental fat deposits and moderate anterior skin laxity. She has lost approximately 30 pounds but has had a stable weight for the past year. She does not desire an open facial and neck rejuvenation procedure. A limited neck and submental VAL was recommended with

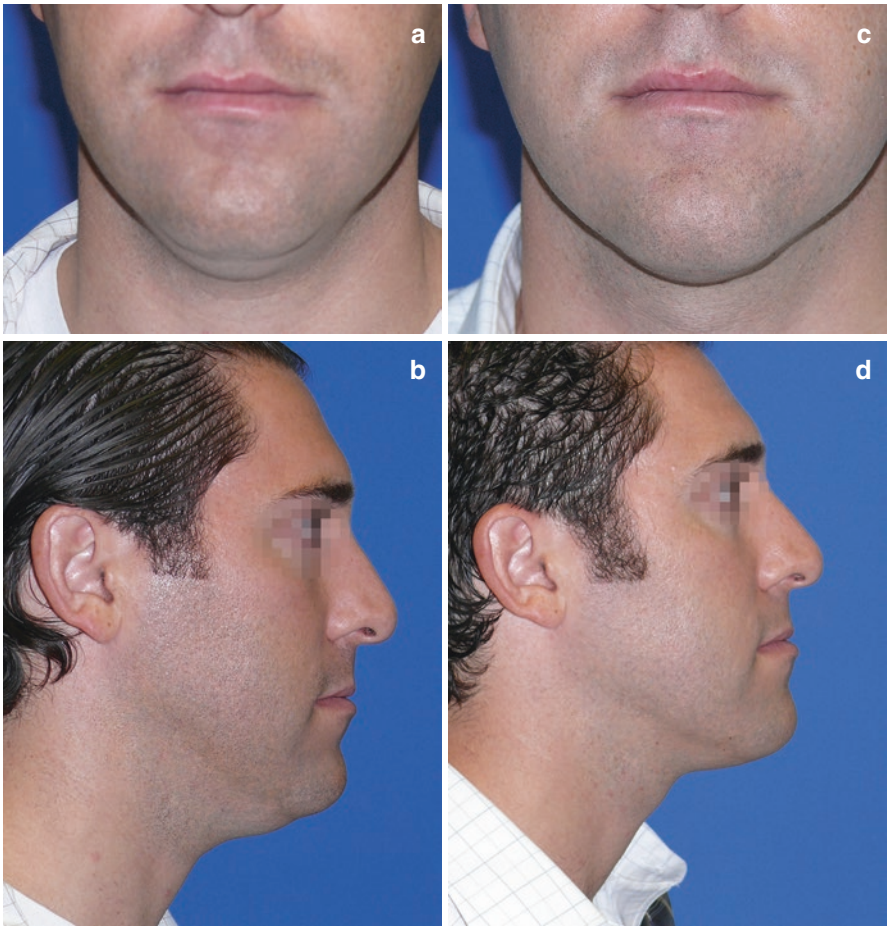

Fig. 5.8 A 30-year-old male patient with moderate to severe submental lipodystrophy underwent VASER-assisted liposuction of the submental area and neck. Preoperative appearance (**a**, **b**). Postoperative appearance at 4 months (**c**, **d**)

slightly extended VASER exposure time. The patient appeared to have realistic expectations for a postoperative result and was well aware of the contouring limitations imposed, as a result of her neck skin laxity. The outpatient surgery was performed under general anesthesia. Retro-auricular and submental incisions were used for access. The author's general anesthesia wetting solution formula was infused at 250 ml per minute to a total volume of 300 ml. A higher wetting solution volume was utilized to allow slightly longer VASER exposure and to extend the treatment along the lateral neck to include a greater surface area in the skin retraction. A 2.4 mm, five-ring VASER probe at 60% energy level was applied for 3 minutes and 30 seconds in pulsed mode. The liposuction was performed with a 3 mm VentX cannula. A total volume of 90 ml was extracted from the neck and submental areas. A facial compression garment was applied over shaped TopiFoam at the conclusion of the

surgery. Surgical results at 6 months are depicted in Fig. 5.9a–d. Occasionally VAL techniques are used as an adjunct to facial rejuvenation open procedures. The use of VAL in these cases is helpful in defatting the submental area and better defining the

Fig. 5.9 A 52-year-old female patient with severe submental lipodystrophy underwent VASER-assisted liposuction of the submental area and neck. Preoperative appearance (**a**, **b**). Postoperative appearance at 6 months (**c**, **d**)

neck line. A 42-year-old woman with significant submental and neck lipodystrophy was seen in consultation requesting facial rejuvenation and improvement of her neck contour. Due to some premature signs of facial aging, an open facial rejuvenation procedure complemented by VASER-assisted submental and neck contouring was recommended. She was treated with a 2.4 mm, five-ring VASER probe at 60% energy level for 3 minutes in pulsed mode. Because she was undergoing an open face and neck procedure, the submental extraction and neck contouring were performed aggressively removing 92 ml of total aspirate. Anterior plication of the platysma was performed as part of the rejuvenation procedure since the submental VAL exposed platysma bands. Surgical results at 6 months are depicted in Fig. 5.10a–d.

Some patients with significant lipodystrophy of the submental area as well as signs of facial aging are not willing to undergo open facial rejuvenation procedures. Their appearance can be improved with judicious neck contouring using VASER-assisted liposuction, extending the treatment area over the entire neck in order to allow for better skin retraction. A 49-year-old woman with significant fatty deposits in her submental area and with moderate skin laxity was seen in consultation. She requested improvement of her neck contour but was not willing to undergo an open surgical procedure. Her outpatient surgery consisted of VASER-assisted liposuction of her neck and submental area under general anesthesia. The author's wetting solution for general anesthesia was infused at 250 ml per minute to a total volume of 350 ml. A 2.4 mm, five-ring VASER probe was employed at 60% energy level for 3 minutes and 40 seconds in pulsed mode. Aspiration was performed with 3.0 mm and 2.4 mm VentX cannulas and a total volume of 115 ml was extracted. Surgical results at 8 months are depicted in Fig. 5.11a–d.

HIV-Associated Cervicodorsal Lipodystrophy

Another indication for using VAL in the neck is in the treatment of HIV-associated cervicodorsal lipodystrophy. Suppression of viral replication by means of highly active antiretroviral therapies (HAART) is part of the current therapy used in the treatment of human immunodeficiency virus (HIV). Although these drugs have increased survival for patients infected with HIV, their use is associated with several metabolic complications and morphologic changes. The condition was first described by Carr [7] and can occur in 10–60% of HIV patients receiving these therapies [8]. Plastic surgeons are sometimes called upon to treat abnormal fat redistributions resulting from the prolonged use of these drugs. These abnormal fat deposits are frequently found in the neck particularly in the cervicodorsal region. The deposits can be significant in size and can present as an aesthetic problem but can also be highly uncomfortable for the patient since they are associated with a variety of symptoms such as pain, postural changes, sleep apnea, and range of motion limitations [9]. Ultrasonic-assisted liposuction has been reported by Hultman et al. [10] to be a highly efficient method of treatment for this extremely tight and fibrous fatty deposit. Davidson et al. [11] proposed an algorithm for the surgical management of this condition. A suitable candidate for surgical treatment has stable HIV disease, is under the care of an infectious disease specialist, has laboratory values (cell counts and viral panels) consistent with safe surgery, and has realistic expectations about the aesthetic

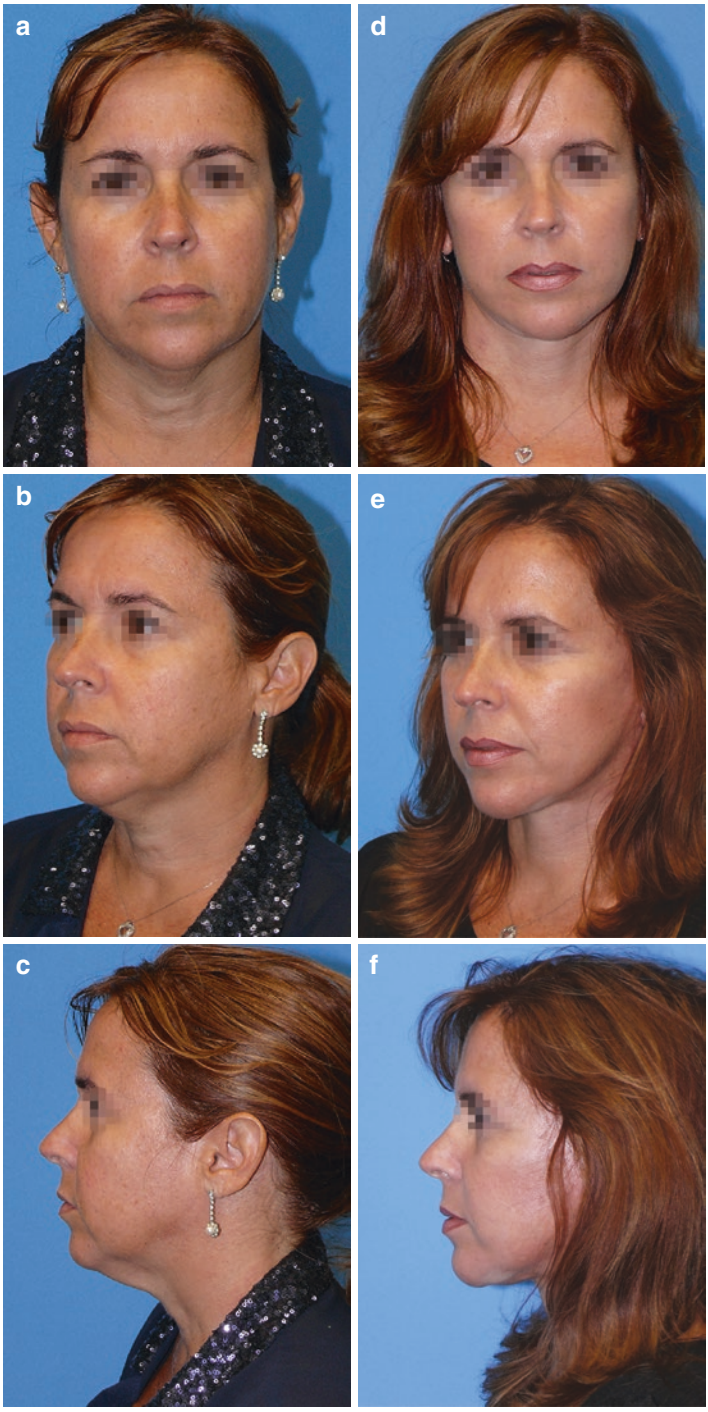

Fig. 5.10 A 45-year-old with large-volume submental fat underwent facial rejuvenation surgery with VASER-assisted liposuction of neck and submental area. Preoperative appearance (**a**, **b**, **c**). Postoperative appearance at 5 months (**c**, **d**, **e**)

Fig. 5.11 A 49-year-old woman undergoes VASER-assisted liposuction for correction of extensive lipodystrophy of her submental area. Preoperative appearance (**a**, **b**). Postoperative appearance at 8 months (**c**, **d**)

and functional outcomes. Informed consent should discuss the possibility of recurrence of the deformity, incomplete resection, and the possibility for further surgery.

Surgical Technique

The author's approach to the treatment of this condition is similar to the treatment employed in highly fibrous gynecomastia. The wetting solution consists of 1 ml of 1:1000 epinephrine in 1 L of lactated Ringer's solution at room temperature. A significant amount of fluid is used. The infusion rate is 300–400 ml/minute evenly distributed throughout the area to the point of tumescence. One- or two-ring ultrasound probes are used and the energy settings are 80–90% in continuous mode. The

time exposure will vary depending on the volume of fat being treated and the fibrous nature of the tissue. The endpoint should be a lack of tissue resistance to the probe. Aspiration is performed with 3.7 and 3.0 mm VentX cannulas.

A 48-year-old woman diagnosed with HIV and currently under treatment is seen in consultation regarding enlarging cervicodorsal lipodystrophy. The condition has become symptomatic and is affecting her neck range of motion. A VAL of the area was recommended and after obtaining full medical clearance she will undergo the outpatient surgery under general anesthesia. The author's wetting solution for general anesthesia was infused at 300 ml per minute. A total of 750 ml of the solution was infused, with fairly even distribution throughout the lipodystrophy area. A 3.7 mm, two-ring VASER probe at 80% energy level was employed for 3 minutes and 40 seconds in continuous mode. Aspiration was performed with 3.7 mm and 3.0 mm VentX cannulas. A total of 340 ml of aspirate was extracted. Surgical results at 3 months are depicted in Fig. 5.12. Sheets of TopiFoam and a compression vest

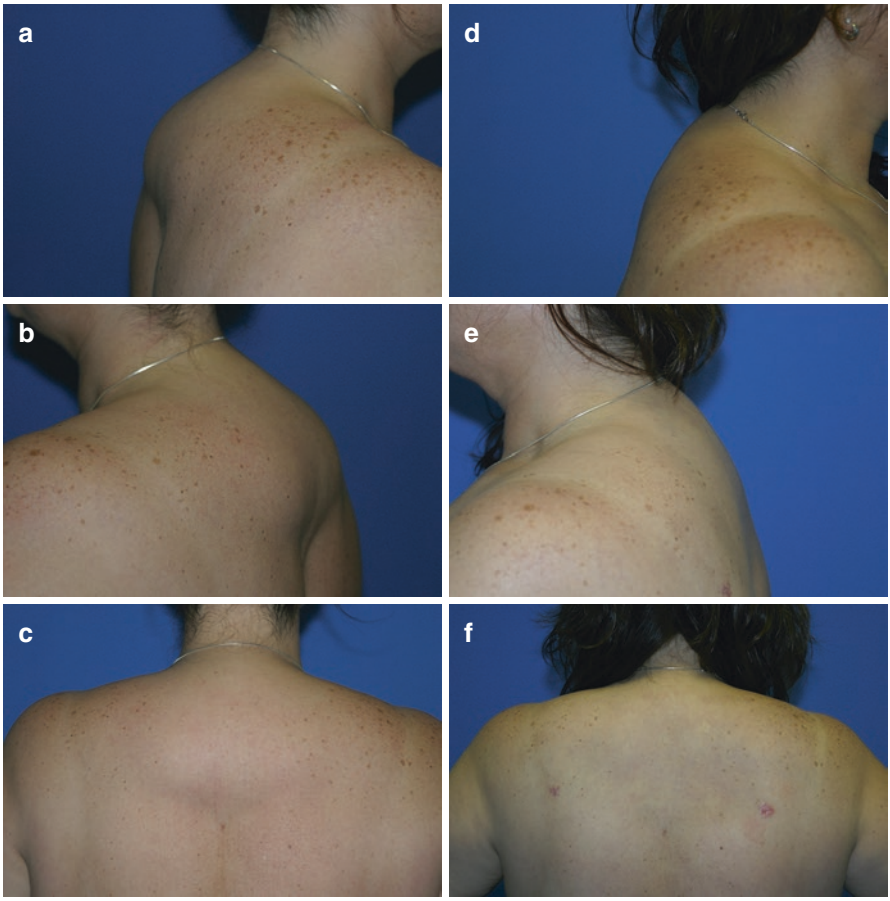

Fig. 5.12 A 48-year-old female with HIV-associated cervicodorsal lipodystrophy. Preoperative appearance. (**a**) Posterior, (**b**) left lateral, (**c**) right lateral. Postoperative appearance at 4 months. (**d**) Posterior, (**e**) left lateral, (**f**) right lateral

are employed postoperatively for 3–4 weeks and moisturizing massages are started after the first week as tolerated.

Conclusion

VASER-assisted liposuction of the neck and submental area is a safe and effective method for aesthetic contouring of these areas. In the author's experience it is associated with minimal complications and high patient satisfaction. The VAL technique is also an efficient method of treatment for HIV-associated cervicodorsal lipodystrophy.

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Chapter 6
Contouring of the Trunk

Onelio Garcia Jr.

Liposuction is currently the second most common aesthetic surgical procedure performed by plastic surgeons [1] and the trunk is one of the most common areas for which patients seek liposuction. When contouring the trunk either with traditional suction-assisted lipectomy (SAL), ultrasound-assisted liposuction (UAL), or VASER-assisted liposuction (VAL), a circumferential approach typically results in a more harmonious aesthetic result than "spot" liposuction. VAL is the third-generation version of UAL and produces efficient fragmentation of the fatty tissue matrix while delivering only about half of the ultrasound energy to the tissues of previous UAL devices. In all these cases, the patients will need to be repositioned on the operating table during the surgery in order to gain access to all the areas involved in circumferential contouring. Needless to say this repositioning leads to lengthier surgeries and prolonged anesthesia.

As with any body contouring procedure, successful outcomes begin with appropriate patient selection. It used to be that liposuction was reserved for young, healthy patients, close to their ideal body weight and with discreet, well delineated fatty deposits. A better understanding of tissue dynamics when contouring large surface areas and the advent of VASER-assisted liposuction has expanded the patient selection criteria for liposuction procedures. We now frequently offer these procedures to older patients, overweight patients, and those with disseminated lipodystrophy if they meet certain conditions. First and most important of these conditions is that the patient's health status is verified by a comprehensive preoperative medical clearance and is deemed to be compatible with the rigors of the planned surgery; second is that the skin turgor and elasticity will allow removal of sufficient aspirate volumes

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O. Garcia Jr. (✉)
Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

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that will not only yield the desired physical contour but also maintain adequate skin tone. Last but not least is that the patient's expectations are in line with what can realistically be accomplished. Many older or overweight patients who in the past were deemed poor surgical candidates for liposuction and were denied the surgery are currently undergoing ultrasonic-assisted liposuction. If the aforementioned criteria are met, the procedures are associated with good aesthetic results and high patient satisfaction. The fact that the Cosmetic Surgery National Data Bank Statistics from the American Society for Aesthetic Plastic Surgery (ASAPS) shows a steady increase from year to year in the number of liposuction procedures performed is a testament to the high patient satisfaction rate associated with the procedure. Over 300,000 liposuction cases were reported to the (ASAPS) Data Bank last year, a 16% increase from the previous year and a 58% increase over the past 5 years! Undoubtedly the increase in liposuction surgeries stems not only from the high satisfaction rate with procedure but also to a great extent from the expanded patient selection criteria. It is worth mentioning again that liposuction surgery is still not for everyone, even with the expanded patient selection criteria associated with the use of VAL. As a purely aesthetic, elective procedure, prospective patients need to be in excellent health, the skin turgor and elasticity should be appropriate so that the patient is not trading fatty deposits for loose skin, and the patient expectations should be realistic since liposuction is not an alternative to proper diet and physical exercise.

The approach to contouring of the trunk varies from females to males and from younger patients seeking a more athletic appearance in a swimsuit to older patients just seeking improvement in physical proportions and better fitting garments. For example, when contouring the posterior trunk in males a "V" shape is desired. This is created by the musculature of the back tapering down to a straight, narrow waist. On the other hand females require a more feminine back contour which begins at the top of the posterior axillary crease and tapers down to a small curved waistline which again widens at the level of the hips. Extensive flank liposuction in females creating narrow waistlines without addressing the upper back can create a masculine contour. For this reason, the author recommends addressing the entire surface area of the posterior flanks and upper back during circumferential trunk contouring procedures. The abdomen is not a flat surface and as such attempts should be made to highlight the normal anatomical landmarks, thus creating a more natural appearing result devoid of liposuction surgery stigmata.

Preoperative Considerations

Prospective patients for abdominal contouring should be evaluated for the presence of rectus muscle diastasis, abdominal hernias, abdominal scars, skin elasticity, location of the fat, supra-umbilical or infraumbilical, and how much of it is

intraperitoneal vs extraperitoneal. It is imperative to make a realistic assessment of the amount of fat that can be removed without adversely affecting the skin tone. For the experienced body contouring surgeon sometimes a pinch test and visual provides the information needed to create a treatment plan. The surgeon with less experience in body contouring may find a modification of the Matarasso classification proposed by Rohrich, Beran, and Kenkel [2] helpful in assessing these patients and formulating a treatment plan.

The back and flanks are more forgiving anatomical areas than the abdomen when it comes to liposuction. The dermis is thicker in these areas and the fat is dense, fibrous, and tightly compartmentalized. This makes it difficult to aspirate using traditional liposuction techniques which are associated with greater amounts of blood in the aspirate [3]. The back rolls are also extremely difficult to correct with SAL which is why many of the cases performed with traditional liposuction are associated with incomplete correction of the back rolls postoperatively. It is for these reasons that the author currently uses VAL for all circumferential contouring surgeries of the trunk. VAL technology is highly efficient at fragmenting back fat with minimal tissue trauma and provides a nearly bloodless aspirate. One of the liposuction surgery endpoints should be the presence of bloody aspirate. In a large reported series the author was able to aspirate over three times as much fat volume from the back without blood in the aspirate with VAL as opposed to when using SAL [4].

Preoperative photography is performed with the patient standing with feet shoulder width apart. All garments are removed in order to expose the areas to be contoured without the distortion created by the bra and elastic bands in the underwear. Typically, eight views are taken for body contouring procedures of the trunk. Front view, front oblique left and right, posterior oblique left and right, lateral left and right, and a posterior view (Fig. 6.1a–f). Lately I have been adding a view of the buttock area from lower back to mid thighs (Fig. 6.2) because extensive contouring of the posterior trunk has a profound visual effect on the buttock shape. This will be detailed elsewhere in this book in the Gluteal Contouring chapter.

Preoperative markings are performed in the standing position. In females I usually mark the abdomen first making sure that I address both, the linea alba and linea semilunaris with my markings. Also the location of the anterior superior iliac spine is marked since creating a shadow effect in that area provides a very athletic appearance. Using the pinch test, the areas of extraperitoneal fatty deposits are mapped out. In the typical female patient undergoing VASER-assisted liposuction of the abdomen, the idea is to evacuate as much extraperitoneal fat as the skin turgor allows and to create the natural shadow effects of the anatomical landmarks without the extensive etching performed in the high-definition body sculpting discussed elsewhere in this book. In males the markings are slightly different. The midline is marked mostly above the umbilicus, the lateral edges of the rectus muscles are marked, and the suboblique triangle described by Hoyos [5] is also marked (Fig. 6.3). Markings of the posterior trunk are depicted in Fig. 6.4 and include the location of the back roll creases.

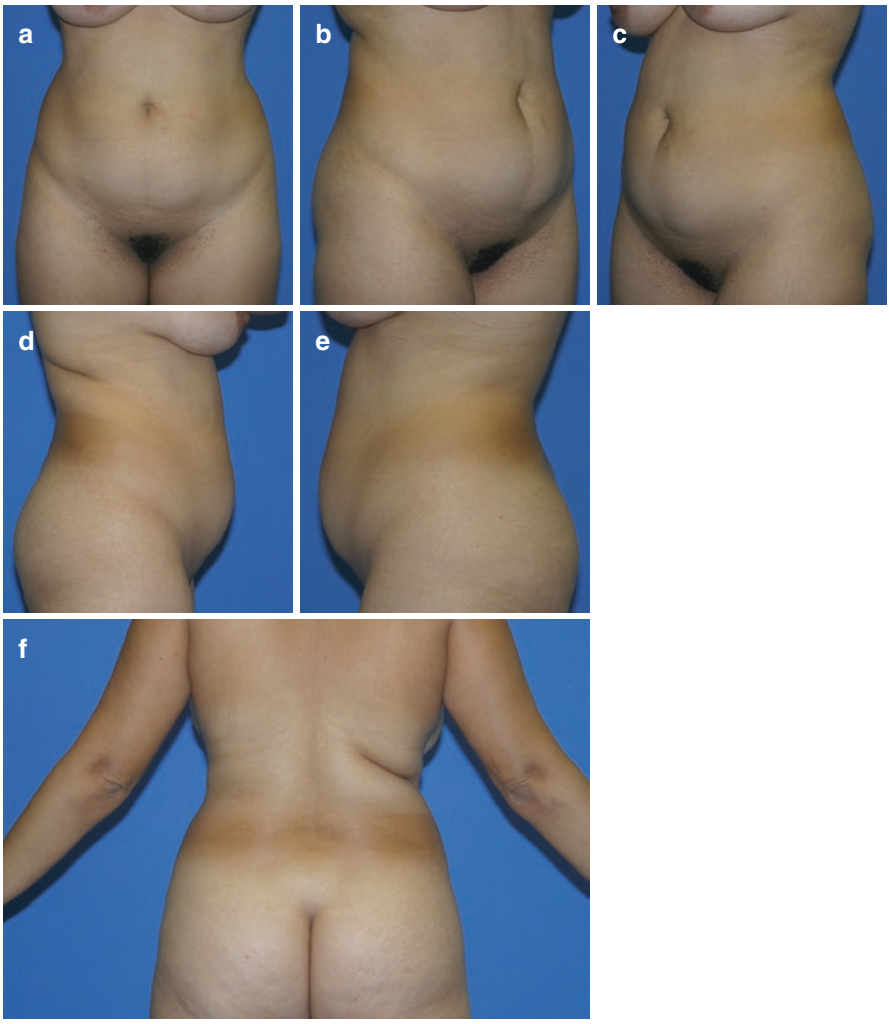

Fig. 6.1 (**a**–**f**) Preoperative photography for VAL contouring of the trunk

Surgical Technique

I typically begin circumferential contouring of the trunk with the back and flanks. There are two options for positioning the patient on the operating table and both have pros and cons. The prone position requires meticulous padding of all pressure points from bony prominences and proper protection of the face and breasts. When starting out in this position under general anesthesia, it is useful to perform the anesthesia induction and endotracheal intubation on the stretcher adjacent to the

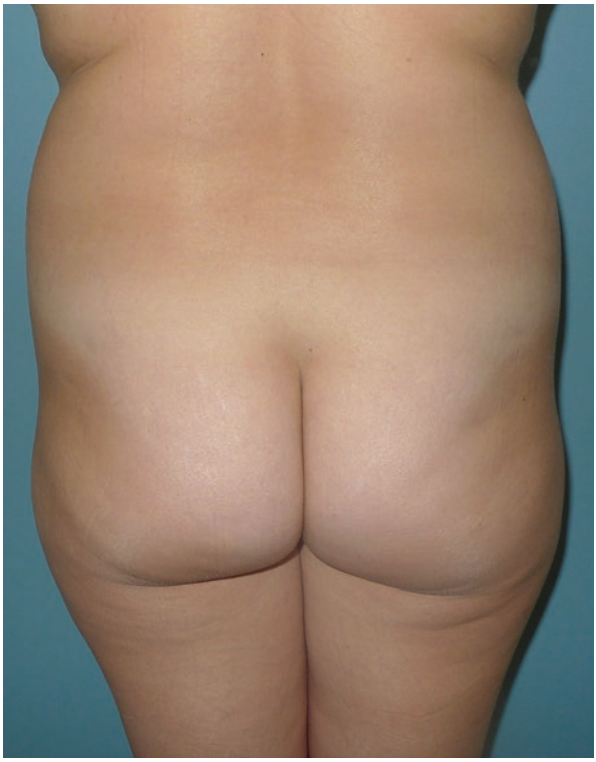

Fig. 6.2 Preoperative buttocks view

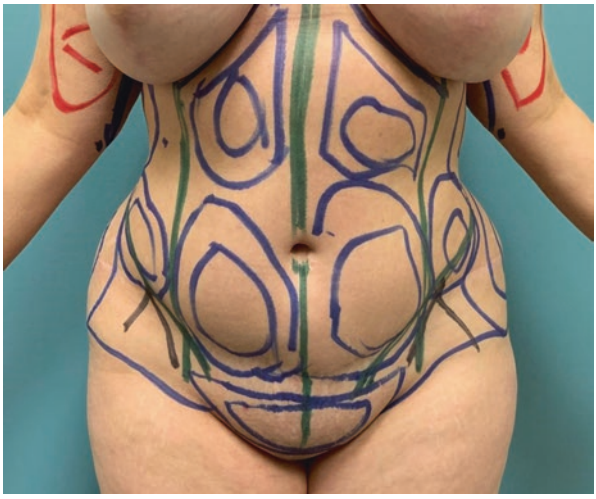

Fig. 6.3 Preoperative markings for VAL contouring of the abdomen

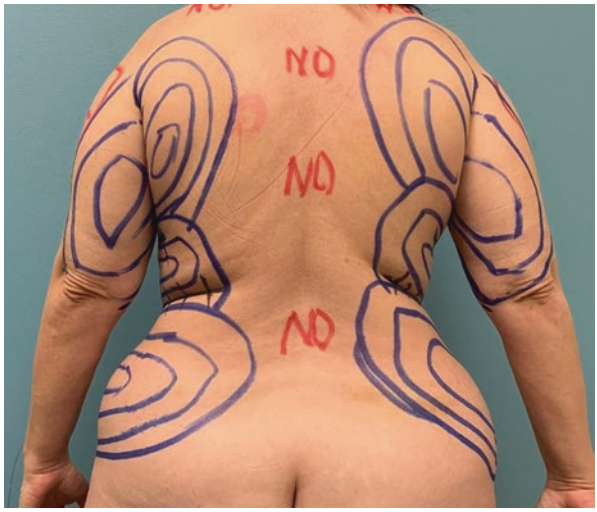

Fig. 6.4 Preoperative markings for VAL contouring of the posterior trunk

operating table and then transferring the patient directly to the table in the prone position over the hip rolls and axillary rolls. The operating table is then flexed slightly to provide better lineal access for the VAL probes and avoid torqueing them over the curved anatomical areas of the back and flanks. The prone position provides fairly good access to the back and flanks and the position makes it easier to access symmetry since the surgeon is visualizing both sides simultaneously during the surgery. Another advantage of the prone position in circumferential contouring is that it requires only one additional patient repositioning to the supine position in order to complete the abdominal areas. In spite of these advantages, many experienced body contouring surgeons, including the author, prefer contouring of the posterior trunk in the lateral decubitus position. This position also requires an axillary roll and padding of the bony prominences. Although this position for liposuction requires an additional repositioning (side-side-supine versus prone-supine), many including the author feel that the lateral decubitus position provides better access for UAL cases with less trauma. The position is extremely helpful when evacuating large volumes from the back and flanks and in the creation of small aesthetic waistlines. Once both sides of the posterior trunk are completed, the patient is then turned to the supine position for completion of the abdominal contouring.

It was once common to perform the surgical prepping for circumferential liposuction prior to induction of anesthesia. The patient in the standing position would be sprayed in a circumferential manner using povidone-iodine (Betadine) solution. The operating table would be draped with the sterile sheets and the prepped patient would lay down on the sterile sheets after which the sterile draping would be completed. This prepping and draping method has been abandoned by many including the author who now prefers to prep and drape an anesthetized patient in the surgical position on the operating table using povidone-iodine (Betadine) gel. Access incisions for abdominal VAL are typically placed in the upper pubic area (below the

bikini line) on each side and in the midline. Another access incision is placed in the superior internal aspect of the umbilicus for access to the upper abdomen. The author usually performs liposuction surgery of large surface areas under general anesthesia and only small-volume aspirations under local. The "superwet" guidelines call for an approximate 1:1 ratio of fluid infiltrate to expected aspirate volume; however this is not nearly enough wetting solution for VAL surgery. In the author's experience these cases require a minimum of 3:1 ratio of wetting solution to expected aspirate volume. The idea is to create a blanched and turgid treatment area. The high volume of fluid in the tissues during VAL cases promotes fat fragmentation and offers a measure of thermal protection. Furthermore, high-volume infiltration is associated with cleaner aspirate since the high hydrostatic pressure aids in hemostasis. For most areas of the trunk, the wetting solution is infiltrated by means of an infiltration pump at a rate of 400 ml/minute until the fluid is evenly dispersed throughout the tissues. There are a number of wetting solution formulas described in the literature [6–8]. For major VAL cases under general anesthesia, the author employs Garcia's formula [9], which consists of 1 ml of epinephrine 1:1000 in 1 liter of Ringer's lactate at room temperature. Formulas that advocate warming the wetting solution are not recommended for ultrasonic liposuction surgeries. For smaller cases under local anesthesia, 30 ml of 1% xylocaine is added to a liter of the wetting solution. At any rate, if xylocaine is used in the wetting solution, the author does exceed a total dose of 35 mg/kg even though some authors claim to use doses exceeding 50 mg/kg while maintaining a safety margin [10, 11]. Smaller surface area liposuctions performed under local do not require such high volumes of wetting solutions, and large surface area cases under general anesthesia do not require the use of xylocaine, so there is really no good reason to push the limits of lidocaine toxicity in these patients. Following the infiltration of the wetting solution, it can take approximately 15 minutes for the patient to experience the full vasoconstrictive effect of the epinephrine; however unlike aspiration cannulas, gently passing VASER ultrasound probes through the tissues is not associated with bleeding so the ultrasound delivery phase is begun immediately after the wetting solution is infused. Prior to aspirating the ultrasound treated area, the next area in line for treatment undergoes infusion of the wetting solution. Employing this infusion protocol, the author has on occasions used cumulative epinephrine doses of up to 14 mg without untoward effects.

Prior to the ultrasound phase, skin protectors are inserted into all the access incisions. A wet sponge is used behind the access incisions to protect the skin from the probes (Fig. 6.5). Currently the author uses a 3.7 mm, three-ring VASER probe (Solta Medical, Bothell, WA) for treating the flanks at 80% energy level in pulsed mode and a 3.7 mm, two-ring VASER probe for the back rolls and upper back at 80% energy level in pulsed or continuous mode. The one-ring probe is seldom if ever used by the author. The endpoint for the ultrasound phase is lack of tissue resistance to the probe. In the early days of VASER liposuction, it was suggested that most areas needed to be exposed to the ultrasound for 1 minute/100 ml of wetting solution to achieve adequate tissue fragmentation. That suggestion proved inaccurate since it has been shown that adequate tissue fragmentation occurs with far less

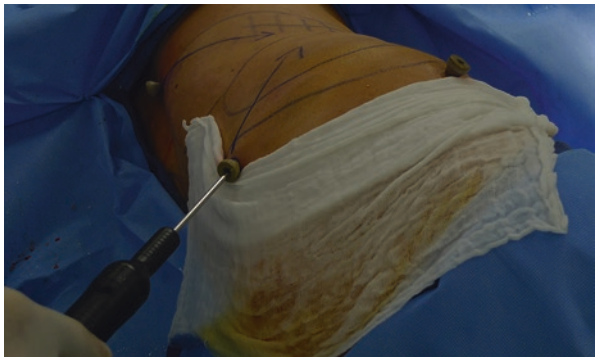

Fig. 6.5 A wet sponge is placed directly behind the skin protectors to protect the skin from the ultrasound probe during the VASER phase of the procedure

Fig. 6.6 Bloodless appearance of typical VASER aspirate

ultrasound exposure. Other than using tissue resistance to the probe as a guideline for ultrasound times which requires some experience with the device, a useful guideline is 1 minute exposure/100 ml of expected aspirate from the area being treated. Typically my VASER ultrasound times for posterior trunk contouring range from 12 to 15 minutes. For the abdomen a 3.7 mm, five-ring probe is used at 70–80% energy level in pulsed mode. Aspiration of the emulsified fat in VAL cases is relatively easy when compared to SAL. The author uses 3.7 mm and 3.0 mm VentX atraumatic cannulas (Solta Medical, Bothell, WA) for the aspiration phase. Typical VASER aspirate from circumferential trunk contouring is relatively bloodless (Fig. 6.6).

Upon completion of the aspiration each access incision is closed with one buried 4-0 absorbable monofilament suture. Drains are not used. TopiFoam is applied over all the treated areas followed by a compression garment (Fig. 6.7a–c).

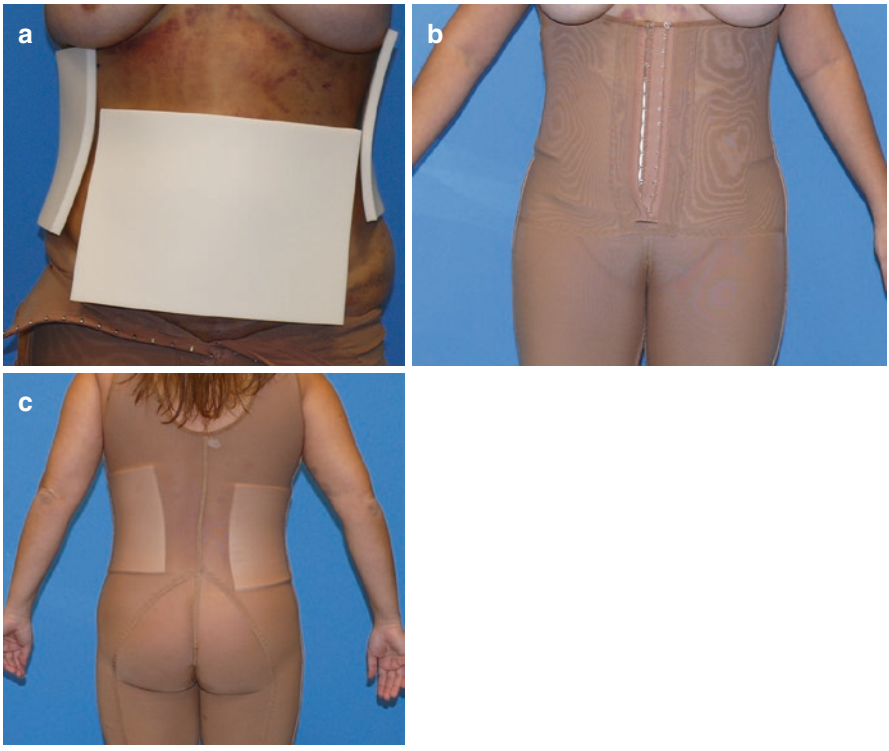

Fig. 6.7 (**a–c**) TopiFoam silicone-backed foam pads are place in direct contact with the skin of the VAL areas. A compression garment is worn over the TopiFoam

A 31-year-old female was seen in consultation regarding contouring of her trunk and extremities. Circumferential VAL of these areas was performed under general anesthesia as an outpatient procedure. Positioning included right lateral decubitus to left lateral decubitus to supine. Wetting solution consisted of 1 ml of epinephrine 1:1000/liter Ringer's lactate solution infused at 400 ml/minute. Three liters were infused into the abdominal area and 5 liters were infused into the posterior trunk. The abdomen was treated with a 3.7 mm, five-ring VASER probe at 80% energy level for 8 minutes in pulsed mode and the posterior trunk was treated with a 3.7 mm, two-ring probe at 80% energy level for 11 minutes in continuous mode. Aspiration was performed with 4.6, 3.7, and 3.0 mm VentX cannulas. Total volume extracted was 6400 ml. Surgical results at 1 year are depicted in Fig. 6.8a–f.

A 38-year-old female patient was seen in consultation regarding improving the contours of her abdomen, flanks, and back. She has some abdominal skin irregularities and a lower abdominal contour deformity from a previous laser liposuction 3 years prior. A circumferential VAL of her trunk with lipo-shifting in the abdomen to correct the irregularities from the previous liposuction plus possible fat grafting of the lower abdominal contour deformity were the recommended procedures. The outpatient surgery was performed under general anesthesia. Positioning included

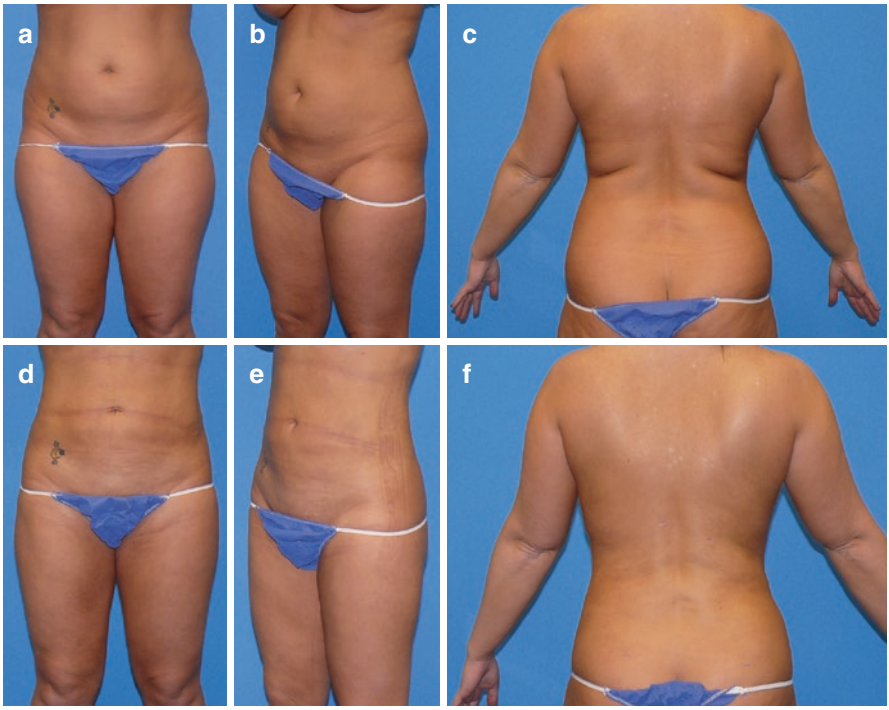

Fig. 6.8 (**a–f**) A 31-year-old woman 1 year post circumferential VAL of the trunk with extraction of 6400 ml of total aspirate

right lateral decubitus to left lateral decubitus to supine. Wetting solution consisted of 1 ml of epinephrine 1:1000/ liter Ringer's lactate solution infused at 400 ml/minute. Three liters were infused into the abdominal and pubic areas and 4 liters were infused into the posterior trunk. Treatment of the abdominal area consisted of a 3.7 mm, three-ring VASER probe in at 80% energy level for 8 minutes in pulsed mode and the posterior trunk was treated with a 3.7 mm, two-ring probe at 80% energy level in pulsed mode for the flanks and continuous mode for the back rolls. VASER exposure time for the posterior trunk was 12 minutes. Aspiration was performed with 4.6, 3.7, and 3.0 mm VentX cannulas. Total volume extracted was 6800 ml. Surgical outcomes after 6 months are depicted in Fig. 6.9a–f.

A 28-year-old athletic male was seen in consultation regarding mild lipodystrophy of his abdomen and flank areas. Due to his excellent skin tone, aggressive circumferential VAL of the abdomen and flanks was recommended. The outpatient surgery was performed under general anesthesia. Positioning included right lateral decubitus to left lateral decubitus to supine. Wetting solution consisted of 1 ml of epinephrine 1:1000 per liter of Ringer's lactate solution infused at 400 ml/minute. Two liters were infused into the abdominal area and 2.5 liters were infused into the flanks. Treatment of the abdominal area consisted of a 3.7 mm, five-ring VASER probe at 80% energy level for 7 minutes in pulsed mode and the flanks were treated

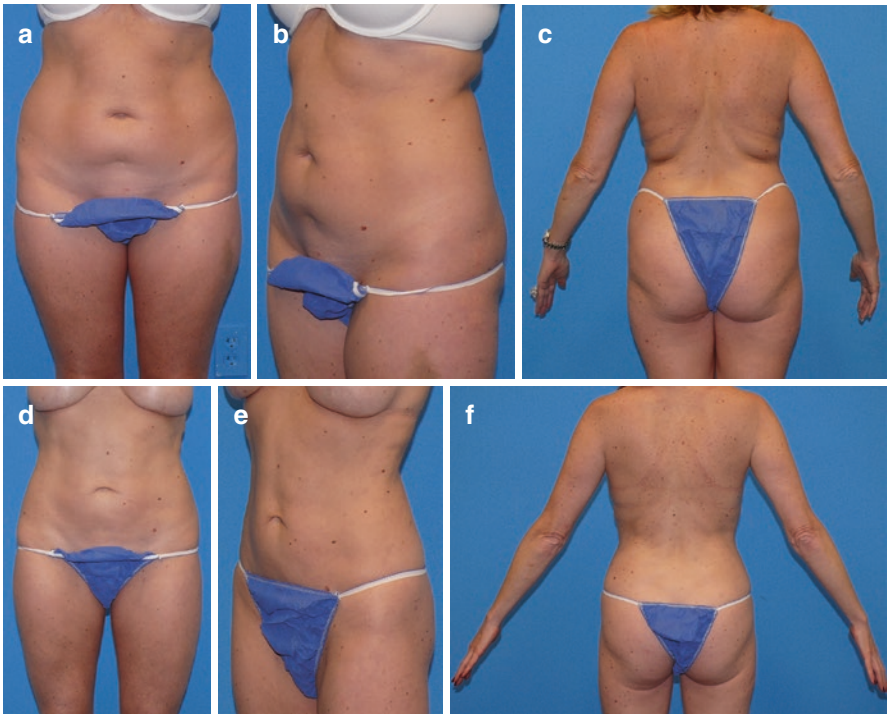

Fig. 6.9 (**a–f**) A 38-year-old woman 6 months post circumferential VAL of the trunk with correction of lower abdominal contour deformity. Volume extracted was 6800 ml of total aspirate

with a 3.7 mm, two-ring probe at 80% energy level for 6 minutes in pulsed mode. Aspiration was performed with 3.7 and 3.0 mm VentX cannulas. Total volume extracted was 2900 ml. Surgical results at 6 months are depicted in Fig. 6.10a–f.

A 30-year-old female, 1 year postpartum, is seen in consultation regarding contouring of her trunk. She has an indented scar in her lower abdomen from her C-section and is actively seeking another pregnancy. Although there is moderate laxity of her abdominal skin, an abdominoplasty procedure was not recommended. Instead, a circumferential VAL of the trunk with partial extraction of the abdominal fat was recommended to improve her contours until she was finished with all her pregnancies and could undergo an abdominoplasty. Since there was a high likelihood of a future pregnancy, the C-section scar was not addressed. The outpatient surgery was performed under general anesthesia in the lateral decubitus-to-lateral decubitus-to-supine positions. Three liters of the wetting solution (author's formula for general anesthesia cases) were infused at a rate of 400 ml per minute into the abdomen and another 3 liters were infused into the posterior trunk. The abdomen was treated with a 3.7 mm, five-ring VASER probe at 80% energy level for 7 minutes in pulsed mode and the posterior trunk was treated with a 3.7 mm, two-ring probe at 80% energy level for 9 minutes in continuous mode. Aspiration was performed with 4.6 mm, 3.7 mm, and 3.0 mm VentX cannulas. Due to the postpartum

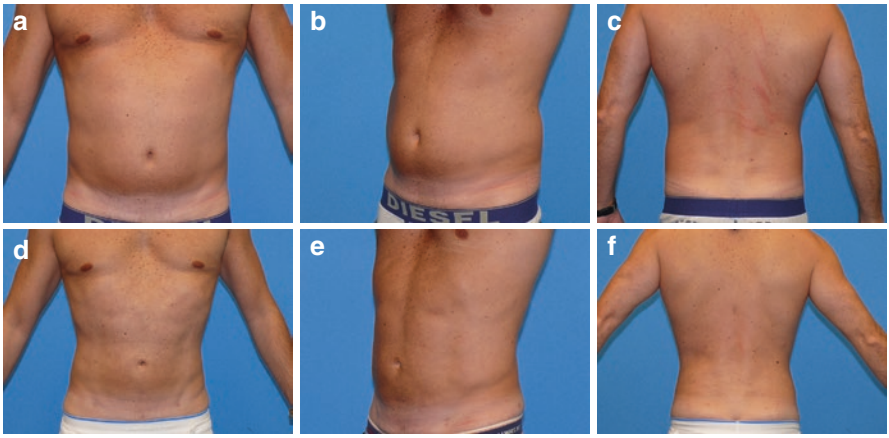

Fig. 6.10 (**a–f**) A 28-year-old athletic male is 6 months post circumferential VAL of abdomen and flanks. Volume extracted was 2900 ml of total aspirate

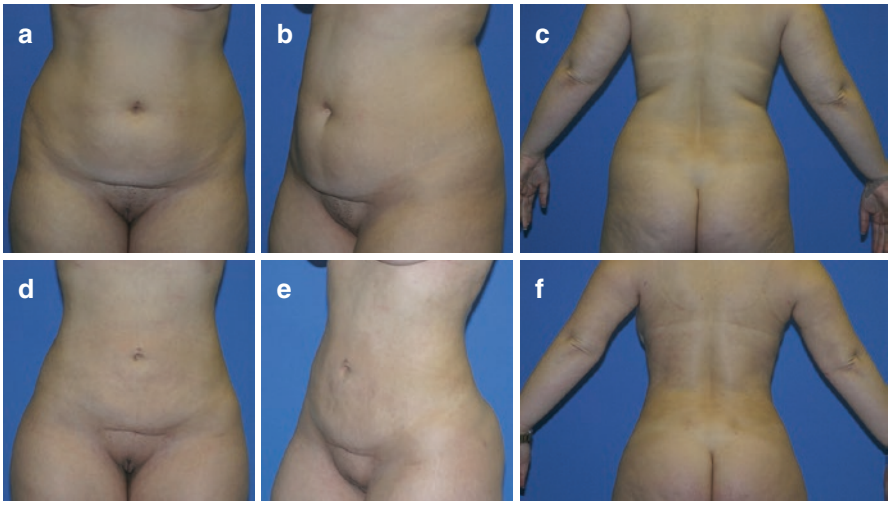

Fig. 6.11 (**a–f**) A 30-year-old postpartum female 5 months post circumferential VAL of trunk. Due to abdominal skin laxity the abdomen was treated conservatively (75% of excess fat extracted); however the posterior trunk was treated aggressively. A total aspirate volume of 6700 was extracted

skin laxity, the abdominal area was treated conservatively, removing only approximately 75% of the excess fat, while the posterior trunk which exhibited good skin tone was treated aggressively. A total volume of 6700 ml was extracted. Surgical outcomes at 5 months are depicted in Fig. 6.11a–f.

Occasionally patients with poor abdominal skin tone and significant striae due to pregnancies may not be ready or willing to undergo open abdominoplasty procedures, particularly if they are planning future pregnancies. Circumferential VASER-

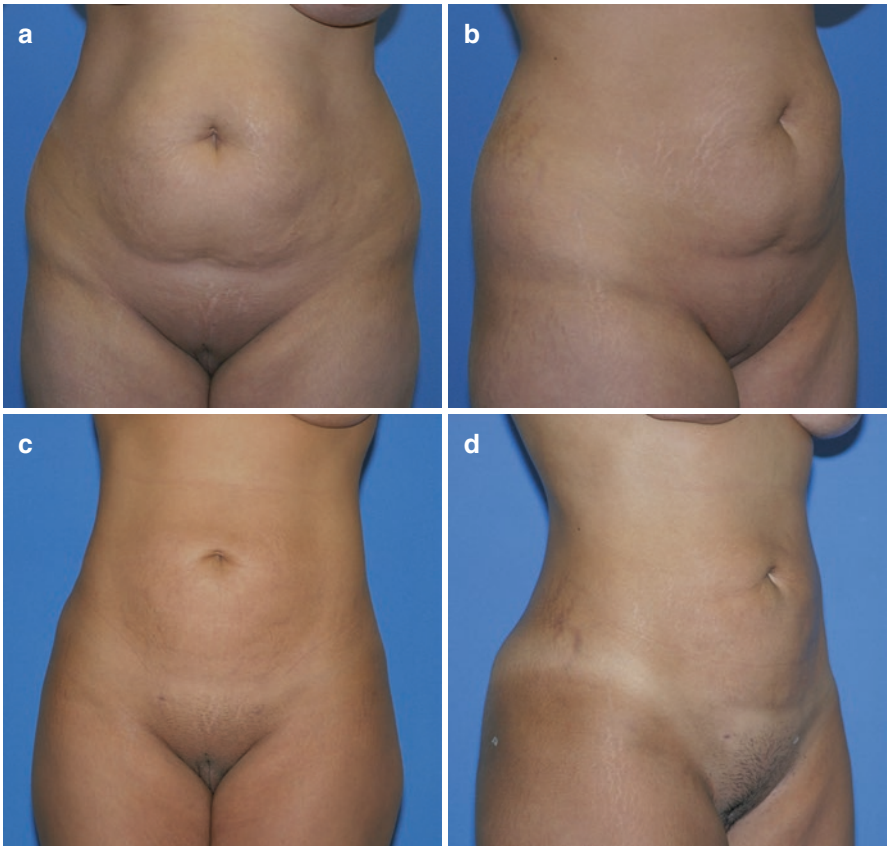

Fig. 6.12 (**a–d**) Patients with significant postpartum skin laxity and striae unable to undergo abdominoplasty procedures can obtain improved abdominal contours from partial VAL of the abdomen

assisted liposuction of the trunk can improve the abdominal contour and waistline in these patients (Fig. 6.12a–d). Although the poor skin quality remains unchanged following VAL, the improvement in body contour affords these patients the opportunity to display a more attractive physique in a one-piece swimsuit until they are ready to undergo an open procedure for resection of the redundant abdominal skin.

Overweight patients with good skin quality without striae but poor skin laxity are sometimes not willing to undergo open abdominoplasty procedures. Circumferential VAL of the trunk can offer a significantly improved contour at the expense of umbilical hooding. Many patients readily accept umbilical hooding secondary to increased laxity in the upper abdominal skin, in exchange for improvement in the contour of their trunk and being able to avoid the abdominoplasty scar. This procedure does not preclude these patients from undergoing an abdominoplasty at a later date so no surgical bridges are burned. The following example is a 41-year-old overweight female with moderate abdominal skin laxity who wanted to improve her trunk

contour but was unwilling to accept an abdominoplasty scar. During consultation she readily accepted some increased skin laxity and umbilical hooding in exchange for improved contour and avoidance of a long abdominal scar. The outpatient surgery was performed under general anesthesia in the lateral decubitus-to-lateral decubitus-to-supine positions. Three liters of the author's wetting solution formula for general anesthesia cases were infused into the abdomen at a rate of 400 ml per minute and 4 liters were infused into the posterior trunk. The abdomen was treated with a 3.7 mm, five-ring VASER probe at 80% energy level for 8 minutes in pulsed mode. The posterior trunk was treated with a 3.7 mm, two-ring probe at 80% energy level for 9 minutes in continuous mode. Aspiration was performed using 4.6 mm, 3.7 mm, and 3.0 mm VentX cannulas. Due to abdominal skin laxity, the anterior trunk was treated conservatively, extracting approximately 80% of the excess abdominal fat. The posterior trunk however had good skin tone and accordingly was treated aggressively. A volume of 6150 ml of total aspirate was extracted. Surgical outcomes at 1 year are depicted in Fig. 6.13a–h. Note the umbilical hooding present, creating a more horizontal appearance to the umbilicus. Aggressive contouring of the posterior trunk, particularly the waistline, has a profound effect on the buttock shape (Fig. 6.13d, h).

Surgeries associated with large-volume extractions of greater than 7 liters should not undergo the procedure as an outpatient since they require close monitoring of the fluid replacement and urine output. The aspirate contains about a third or less of the wetting solution infused. The other portion constituting approximately 70% of the wetting solution does not eventually get absorbed into the intravascular space as previously reported. The unquantifiable losses through the access incisions due to the increased pressure from the higher infused volumes are significantly higher in large-volume liposuctions. Rolling massages of the treated areas following the aspiration phase can extract a significant portion of the free fluid in the tissues through the access incisions. Although not 70% of the infused wetting solution, a significant amount of the infused fluid does get absorbed during the first 12 hours following major liposuction and this needs to be taken into account when planning fluid replacement. Variability among patients also poses difficulties for using a "one size fits all" formula for fluid management. For these reasons the author suggests leaving an indwelling Foley catheter overnight in large-volume cases and managing the intravenous fluids in accordance with maintaining a urine output of 1 ml/kg/hour. Early ambulation and liberal oral intake is also encouraged in these patients and they are discharged home on the first postoperative day.

A 23-year-old, nulliparous, obese, female patient with significant truncal lipodystrophy was seen in consultation regarding body contouring. This patient was expecting future pregnancies and was not willing to undergo an open abdominal procedure. Due to the high-volume extraction involved, the patient underwent surgery as an inpatient with an overnight hospital stay to monitor fluid replacement. Positioning included lateral decubitus-to-lateral decubitus-to-supine. Wetting solution consisted of 1 ml of epinephrine 1:1000/liter Ringer's lactate solution infused at 400 ml/minute. Four liters were infused into the abdominal area and 6.5 liters were infused into the back and flanks. Treatment of the abdominal area consisted of

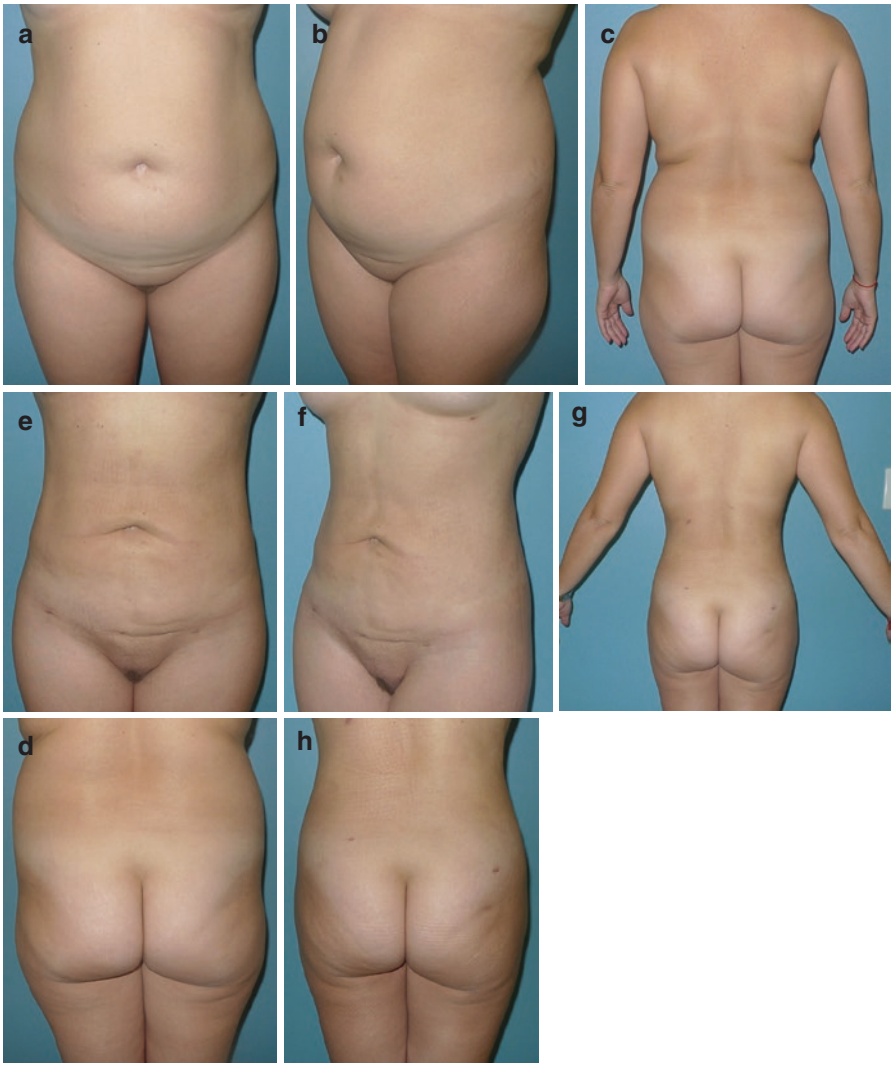

Fig. 6.13 (**a**–**h**) A 41-year-old obese female is 1 year post circumferential VAL of trunk. Note the umbilical hooding in (**e**, **f**) and the improved buttock contour from the aggressive posterior trunk fat extraction (**d**, **h**)

a 3.7 mm, five-ring VASER probe at 80% energy level for 9 minutes in pulsed mode. The posterior trunk was treated with a 3.7 mm, two-ring probe at 80% energy level for 12 minutes in continuous mode. Aspiration was performed with 4.6, 3.7, and 3.0 mm VentX cannulas. Total volume extracted was 11,500 ml. Surgical results 9 months after high-volume, circumferential de-bulking of the trunk are depicted in

Fig. 6.14a–f. Note that the level of contouring in high-volume cases is less than in cases where the patients preoperatively are closer to their ideal body weight. Also note the profound effect that high-volume posterior trunk contouring has on improving buttock shape (Fig. 6.14d, h).

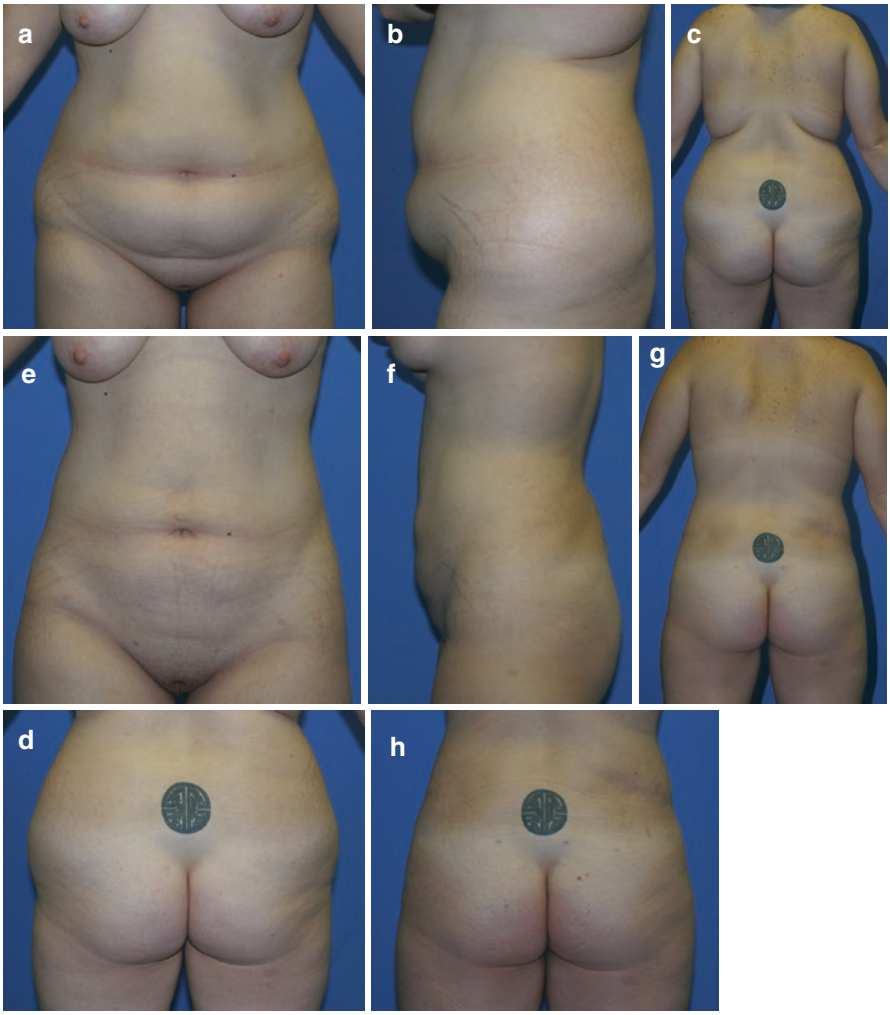

Fig. 6.14 (**a**–**h**) A 23-year-old, obese, nulliparous female is 9 months post high-volume, circumferential VAL of trunk (11,500 ml total aspirate). The abdomen was addressed conservatively due to skin laxity present preoperatively (**a**, **e**). Note the improvement in buttock shape (**d**, **h**), as a consequence of the high-volume contouring of the posterior trunk

Postoperative Considerations

Postoperatively, patients are asked to avoid exposure to heat and humidity, avoid high sodium intake, and avoid strenuous physical activity. Patients are encouraged to ambulate while taking measures to avoid postural hypotension (when getting up from a supine position, first sit up for a minute, then stand up for a minute, and then ambulate). The patients are instructed on liberal intake of PO fluids and the patient and their caretakers are forewarned that they are to expect some fluid leakage through the access incisions that usually subsides by the second postoperative day. Typically patients may shower after 48 hours. Lymphatic massages to the treated areas are quite helpful and can be started at approximately 1 week after the surgery.

VASER-Assisted Lipoabdominoplasty

Another useful application of VASER-assisted liposuction of the trunk is as an adjunct to abdominoplasty procedures. The term lipoabdominoplasty was coined in a landmark article on the subject by Saldanha in 2001 [12]. Since then several authors have reported on the improved outcomes and lower complication rates of this procedure over traditional abdominoplasty [13–17]. This procedure is more than just an abdominoplasty with added liposuction. It is a surgical procedure with its own set of technical components that include extensive liposuction throughout abdomen and flanks (deep layers in supra-umbilical area), dissection above Scarpa's fascia [18] in lower lateral abdominal areas, and limited paramedian dissection in supra-umbilical area preserving the vascular perforators (Fig. 6.15).

VASER-assisted liposuction was becoming popular at about the same time that plastic surgeons were adopting the techniques of lipoabdominoplasty and it did not take long for body contouring surgeons to realize the benefits of VAL in lipoabdominoplasty. Most important of these benefits is that there is less physical trauma exerted on the abdominal flap by the smaller suction cannula gently passed through the tissues in VAL with significantly less blood loss than in traditional SAL [19, 20].

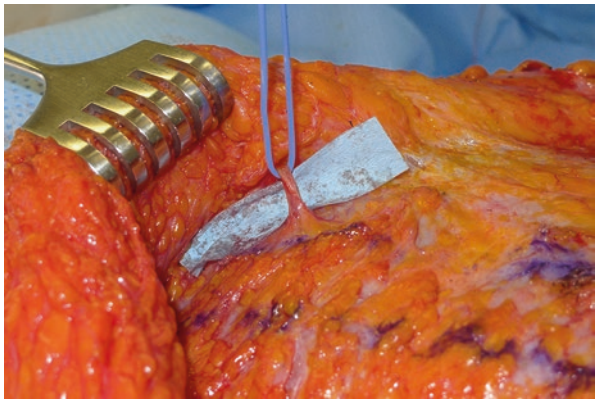

Fig. 6.15 Keeping the superior abdominal dissection well within the lateral borders of the rectus muscles spares these blood vessels which play an important role in the vascular supply of the abdominoplasty flap

Surgical Technique

Access incisions for the VAL are placed in areas where the skin is to be removed as part of the redundant abdominal flap. The wetting solutions are the same as for VAL cases infused with a pump at 300–400 ml/minute and the ultrasound is applied at 70–80% energy level in pulsed mode with the 3.7 mm, five-ring probe. Aspiration is performed with the 3.7 and 3.0 mm VentX cannulas throughout the abdomen but only in the deep sub-Scarpa's layer in the supra-umbilical area since the purpose is to only de-bulk the supra-umbilical portion of the abdominal flap. The suction can be extended over the costal margin which somewhat aids in the release of the abdominal flap. Elevation of the abdominal flap is performed at the level of the rectus fascia within the margins of the rectus muscles, at the level of Scarpa's fascia lateral to the rectus borders in the infraumbilical area, and within the margins of the rectus muscle in the supra-umbilical area. The diastasis repair is confined to the margins of the diastasis (Fig. 6.16a, b). Due to the volume of wetting solution infused into the abdomen and flanks, the author typically uses drains in these cases. However, recently there was a published report in the literature claiming that progressive tension sutures were actually associated with a lower seroma rate than drains in lipoabdominoplasty cases [21]. The resection of the redundant abdominal flap and subsequent closure are performed in the usual fashion as for a standard abdominoplasty.

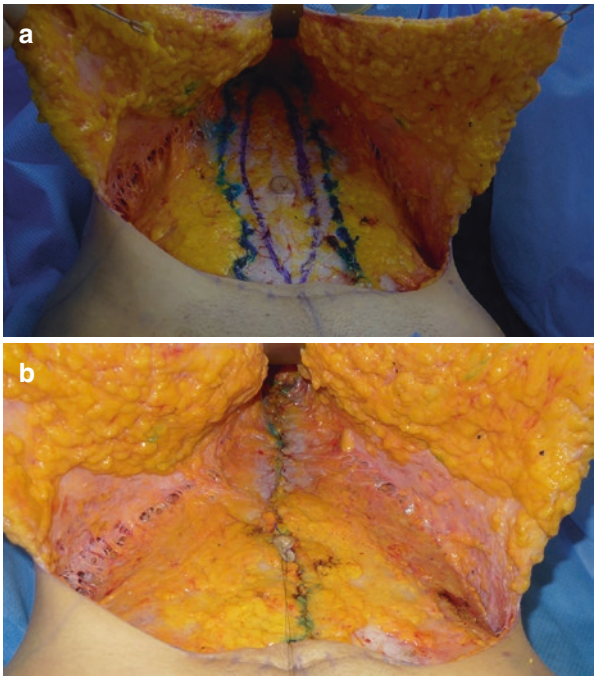

Fig. 6.16 The rectus diastasis and the extent of the repair are marked in (**a**); note that the dissection lateral to the rectus muscles is at the level of Scarpa's fascia. Note that Scarpa's fascia comes together in the midline following the diastasis repair (**b**)

A 24-year-old overweight female is 1 year postpartum and is seeking improvement in the contour of her trunk. Consultation findings included abdominal flaccidity with rectus muscle diastasis, excess extraperitoneal supra-umbilical fatty deposits, extensive lipodystrophy of the posterior trunk with pronounced back rolls, and poor waistline definition. A VASER-assisted lipoabdominoplasty was recommended with circumferential VAL of trunk. The patient, however, was not willing to undergo a lengthy operation with high-volume fat extraction and intraoperative positioning, in order for the surgery to be performed as an outpatient procedure. The surgery was then limited to what could be addressed in the supine position. A VASER-assisted lipoabdominoplasty with contouring of only the anterior flanks was performed. All the surgery was accomplished in the supine position. Wetting solution consisted of 1 ml of epinephrine 1:1000 in a liter of Ringer's lactate solution. A total of 3 liters were infused at 400 ml/minute evenly dispersed throughout the anterior trunk. A 3.7 mm, five-ring VASER probe at 80% energy level was employed for 7 minutes in pulsed mode. Aspiration was performed with 4.6, 3.7, and 3.0 mm VentX cannulas and a total aspirate volume of 1600 ml was extracted. The supra-umbilical, paramedian dissection was limited to an area well within the margins of the rectus muscles. The rectus muscle diastasis repair extended only to the margins of the diastasis. Surgical outcomes at 6 months are depicted in Fig. 6.17a–d.

A 40-year-old female obese patient with abdominal flaccidity and excess truncal lipodystrophy was seen in consultation regarding both volume reduction and improvement in the contour of her trunk. A VASER-assisted lipoabdominoplasty with circumferential contouring of the flanks and back was recommended. The surgery was performed under general anesthesia. Wetting solution consisted of 1 ml of epinephrine 1:1000 in a liter of Ringer's lactate solution. A total of 2 liters were infused into the abdominal area and 4 liters into the posterior trunk at 400 ml/minute. A 3.7 mm, five-ring VASER probe at 80% energy level was employed for 5 minutes in pulsed mode on the abdomen and a 3.7 mm, two-ring probe at 80% energy level was used for 10 minutes in continuous mode in the posterior trunk. Aspiration was performed with 4.6, 3.7, and 3.0 mm VentX cannulas and a total aspirate volume of 3800 ml was extracted. The circumferential VAL allowed for significant volume reduction and creation of a highly defined waistline. Surgical outcomes at 1 year are depicted in Fig. 6.18a–d.

Complications

The complications attributed to VASER-assisted liposuction need to be divided into those that are directly associated with the application of ultrasound energy and those that are associated with liposuction surgery. Most common complications of liposuction surgery involve under-extraction, overextraction, or irregular extraction [22]. Under-extraction is corrected by revisionary secondary extraction, overextraction may require fat grafting, and irregular extraction sometimes requires a

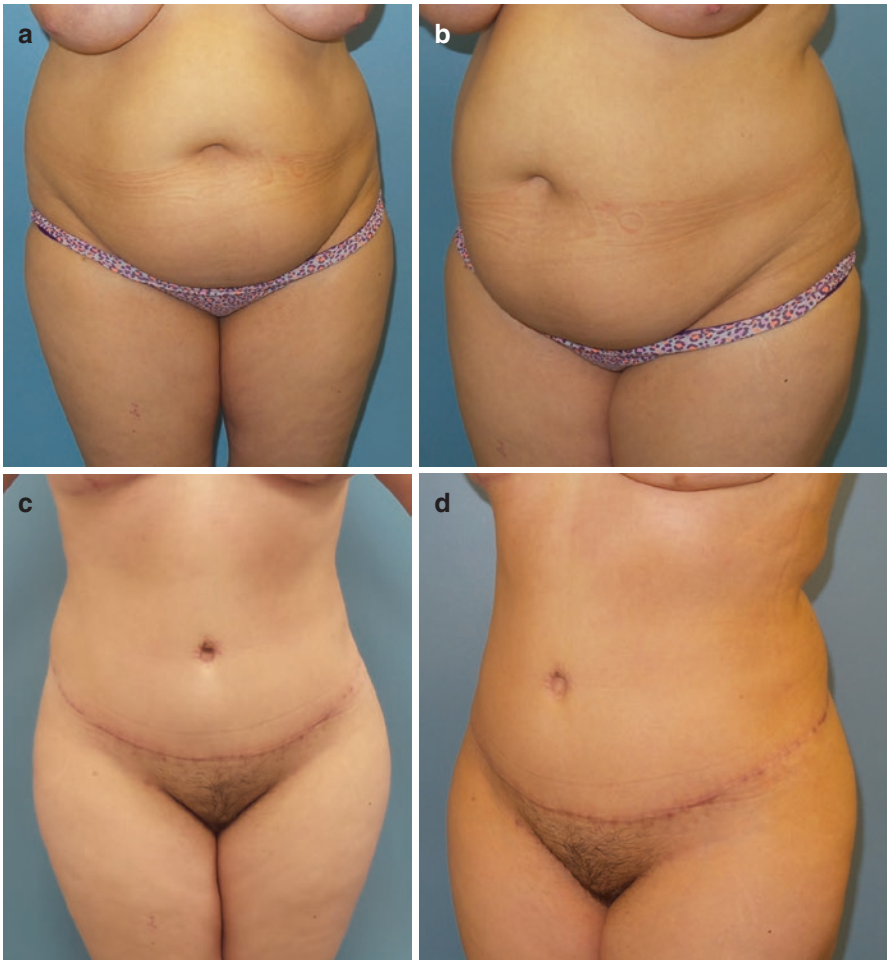

Fig. 6.17 A 24-year-old female is 6 months post VASER-assisted lipoabdominoplasty with only anterior trunk contouring performed entirely in the supine position. Preoperative appearance (**a**, **b**). Postoperative appearance at 6 months (**c**, **d**). Note in (**b**, **d**) how the back rolls are not addressed and the waistline is not fully contoured in the absence of circumferential VAL

combination of extraction, fat grafting, and occasionally external ultrasound treatments [23]. Paresthesias, chronic edema, and ecchymosis are usually self-limiting and are actually found less prominently in VAL than in traditional SAL. Complications related to fluid replacement, DVT, and hypothermia are discussed in detail elsewhere in this textbook in the anesthesia chapter. Seromas following VAL are usually the result of too much ultrasonic energy delivered to the tissues. This is usually a consequence of prolonged exposure or increased generator settings and is rare when clinically recommended settings and ultrasound exposure times are adhered to. Aspiration and compression may be necessary to treat persistent seromas.

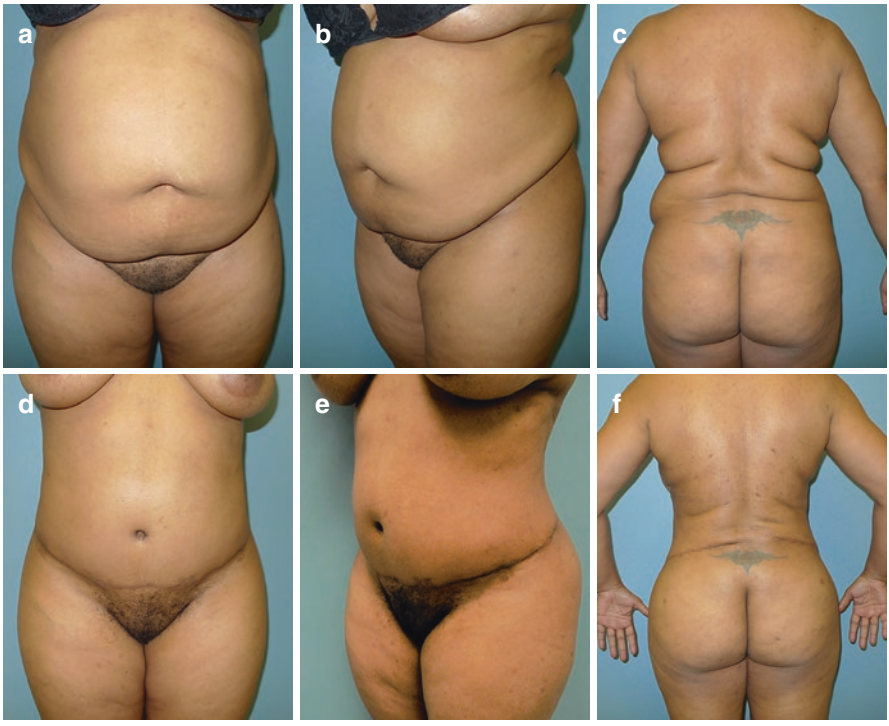

Fig. 6.18 A 40-year-old obese female is 1 year post VASER-assisted lipoabdominoplasty with circumferential VAL of the trunk. Preoperative appearance (**a**, **b**, **c**). Postoperative appearance at 1 year (**d**, **e**, **f**). Note the improvement of the back rolls and the complete contouring of the waistline in (**b**, **e**)

Conclusions

VASER-assisted liposuction of the trunk is associated with less blood loss in the aspirate, precise aesthetic contouring, and decreased postoperative downtimes. It is a safe and effective method of contouring the trunk. Lipoabdominoplasty has been reported to have a lower overall complication rate than traditional abdominoplasty and is associated with more harmonious aesthetic results.

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Chapter 7
VASER-Assisted Liposuction of Gynecomastia

Onelio Garcia Jr.

Gynecomastia is a condition where the glandular tissue of the male breast undergoes benign proliferation resulting in visible breast enlargement. There are a number of etiologies reported in the literature [1–3] such as liver cirrhosis, hypogonadism, tumors of the testicles, kidney disease, and certain drugs; however the majority of the cases are idiopathic, both in adults and postpubertal adolescents. There is still significant controversy among authors regarding the incidence of the condition based on the wide margins reported in the literature. A prevalence of 32–65% has been reported in adult males [4, 5] and a range of 4–69% has been reported in adolescents [6, 7]. Surgery for correction of gynecomastia is currently ranked as the third most common aesthetic surgical procedure in men with over 20,000 cases reported by board certified plastic surgeons in 2017 [8, 9].

There are numerous surgical approaches for the correction of gynecomastia reported in the literature. In the past 20 years, several techniques involving liposuction in combination with glandular resection through minimal, well-concealed incisions have become popular due to their consistently good aesthetic outcomes and a lack of postoperative surgical stigmata. In 1994, Rosenberg [10] published good results treating gynecomastia with only liposuction using an aggressive tip cannula that reportedly also removed glandular tissue. Morselli [11] described a technique that involved traditional suction-assisted lipectomy (SAL) combined with a pull-through technique for gland removal. Several years later Bracaglia [12] published his experience with a similar technique and reported good, consistent results. Hammond et al. [13] modified the previously reported pull-through techniques using ultrasound-assisted liposuction (UAL), with good results, and Ramon et al. [14] introduced the concept of endoscopic visualization to these techniques in 2005. A few years later Lista and Ahmad [15] reported on a similar pull-through technique but this time employing power-assisted liposuction (PAL). Currently the author employs a similar technique using VASER-assisted liposuction (VAL) for the fat extraction.

O. Garcia Jr. (✉)
Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

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Preoperative Considerations

Since the majority of patients who present for evaluation of gynecomastia have either idiopathic adult gynecomastia or the postpubertal idiopathic variety, an extensive hormonal workup is not recommended unless there is a high index of suspicion about an underlying anomaly or other contributing factors such as drugs. Recently, Malhotra et al. [16] reported on a series of 197 patients and concluded that routine endocrinology workups were of little value and that patients with gynecomastia that persisted beyond 16 years of age should undergo surgery as the primary method of treatment. A detailed history and physical along with typical presurgical laboratory studies usually is sufficient preoperative workup in most of these cases. Further diagnostic tests such as hormonal studies, gene karyotyping, or imaging studies should only be reserved for patients where abnormalities are found during their routine preoperative screening. Rohrich et al. [17] reported on the management of gynecomastia and published an algorithm for its evaluation and treatment.

Gynecomastia occasionally presents unilaterally and, in these cases, one should rule out the rare occurrence of male breast cancer. Cancer of the male breast accounts for approximately 1% of all breast cancers and usually presents unilaterally as a firm nodule anywhere on the breast, not necessarily under the nipple-areolar complex. It is associated with high estrogen use, cryptorchidism, Klinefelter syndrome, post-orchiectomy, or exposure to radiation. Although it has been reported at practically all ages, the mean age for male breast cancer is 65 and it has been linked to BRCA1 and BRCA2 genes [18]. Clinical signs can include nipple retraction with or without bloody nipple discharge and skin dimpling. Patients at high risk or with signs related to male breast cancer should undergo mammography which can differentiate malignant from benign masses in the male breast with over 90% sensitivity [19].

Preoperative photography is performed in the anterior, right and left oblique, and right and left lateral views (Fig. 7.1a–e). Preoperative markings are performed in the standing position and extend beyond the anatomical boundaries of the breast to include all lipodystrophy areas involving the chest (Fig. 7.2). It is of paramount importance to also extend inferiorly beyond the inframammary fold into the upper abdomen and to properly disrupt a well-defined inframammary fold.

Surgical Technique

The author typically performs the procedure under general anesthesia. Access incisions extend 3–4 mm and are created with a #15 blade at the lateral inframammary fold and the inferior areolar border. The author's wetting solution formula for general anesthesia cases is composed of 1 ml of epinephrine 1:1000 in a liter of Ringer's lactate solution at room temperature. Infiltration of the wetting solution is performed using a power infusion pump at a rate of 300 ml per minute with even distribution

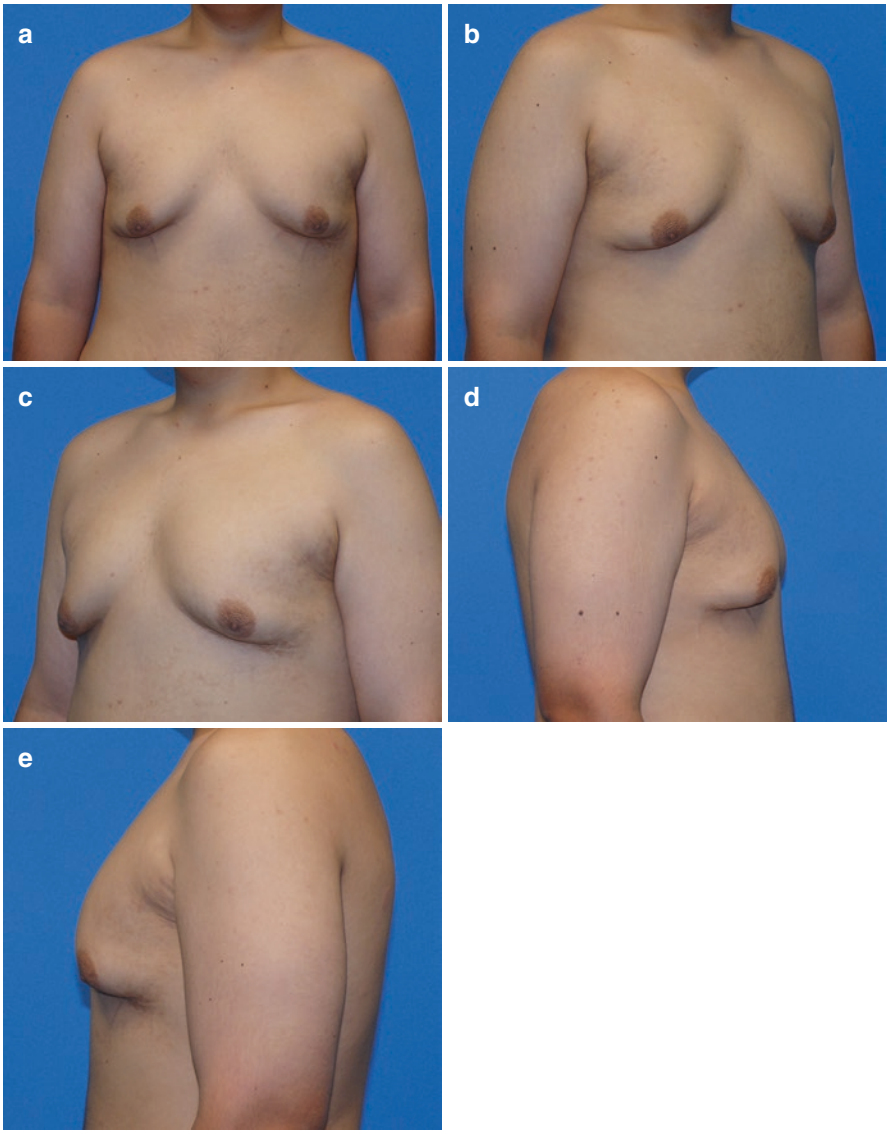

Fig. 7.1 (**a–e**) Preoperative photography for gynecomastia includes anterior view, right and left oblique views, and right and left lateral views

throughout the breast and chest areas to be addressed. Infusion is continued to the point of tumescence including the subdermal space (typically 700–900 ml per side). Although there are "bullet ultrasonic probes" designed specifically for gynecomastia, the author finds that these probes along with the one-ring VASER probe are too aggressive and not really necessary to treat the typical gynecomastia. I employ a two-ring VASER probe (Solta Medical, Bothell, WA) at 80–90% energy level in

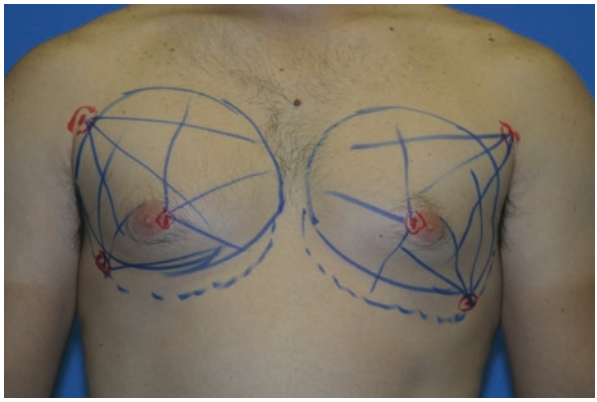

Fig. 7.2 Typical preoperative markings for gynecomastia

continuous mode. The VASER exposure time is 1 minute for every 100 ml of expected total aspirate from the site (typical VASER times are 3–4 minutes per side). Aspiration is performed with 3.7 mm VentX (Solta Medical, Bothell, WA) cannulas for de-bulking and a 3 mm VentX cannula superficially. The pull-through technique for the removal of the fibro-glandular tissue is performed through the access incisions. There are a number of grasping forceps or clamps that have been described as useful for removal of gynecomastia tissue using the pull-through technique. I find tendon forceps work well in most cases and I avoid the use of sharp cannulas such as the Toledo forked cannulas because I find them too traumatic and associated with more postoperative ecchymosis. I do not hesitate to use a small curved, blunt scissor to cut some of the fibro-glandular tissue that does not readily pull through. Bleeding has not been an issue due to the significant hydrostatic pressure from the high-volume tumescence and the epinephrine effect on the tissues. Postoperative dressings include TopiFoam and a compression vest (Fig. 7.3). The surgery is performed as an outpatient procedure and patients are seen for their first visit on the third postoperative day. Depending on the volume extracted, the compression garment is worn between 1 and 2 months. Patients usually return to work after 5 days and avoid strenuous exercise for the first month.

Complications

During the informed consent process patients are advised of the possibility of postoperative hematoma, infection, visible scarring, nipple-areola depression deformity, contour irregularities, skin burns, and sensory changes to the nipples or breast skin. In reality complications are quite rare with this technique and the use of high amounts of epinephrine containing wetting solutions at room temperature has had a tremendous impact on avoiding the excessive bleeding and hematomas associated with the open techniques for treating gynecomastia.

Fig. 7.3 Compression garment used postoperatively following gynecomastia surgery

Surgical Outcomes

A 26-year-old male with persistent idiopathic bilateral gynecomastia was seen in consultation. VASER-assisted liposuction with resection of the subareolar fibroglandular tissue with a pull-through technique was recommended. The surgery was performed under general anesthesia as an outpatient procedure. Wetting solution consisting of 1 ml of epinephrine 1:1000 in a liter of Ringer's lactate solution at room temperature was infused at 300 ml per minute to a total of 750 ml per side. Ultrasound was delivered by means of a 3.7 mm, two-ring, VASER probe at 80% energy level in continuous mode for 3 minutes per breast. Aspiration was performed with a 3.7 mm VentX cannula for the deep tissue and a 3 mm VentX cannula for the superficial, subdermal liposuction. The supernatant fat aspirate volume consisted of 175 ml from each breast. Following the aspiration of the fatty tissues, the fibroglandular component was resected via the pull-through technique. Surgical outcomes at 6 months are depicted in Fig. 7.4a–f. The subareolar glandular tissue and VASER fat aspirate are depicted in Fig. 7.4g, h.

A 44-year-old, healthy, male patient with longstanding history of asymptomatic gynecomastia was seen in consultation requesting aesthetic improvement of his chest contour. VASER-assisted resection of gynecomastia was recommended. The surgery was performed under general anesthesia as an outpatient procedure. The author's wetting solution formula for general anesthesia was infused at 300 ml per

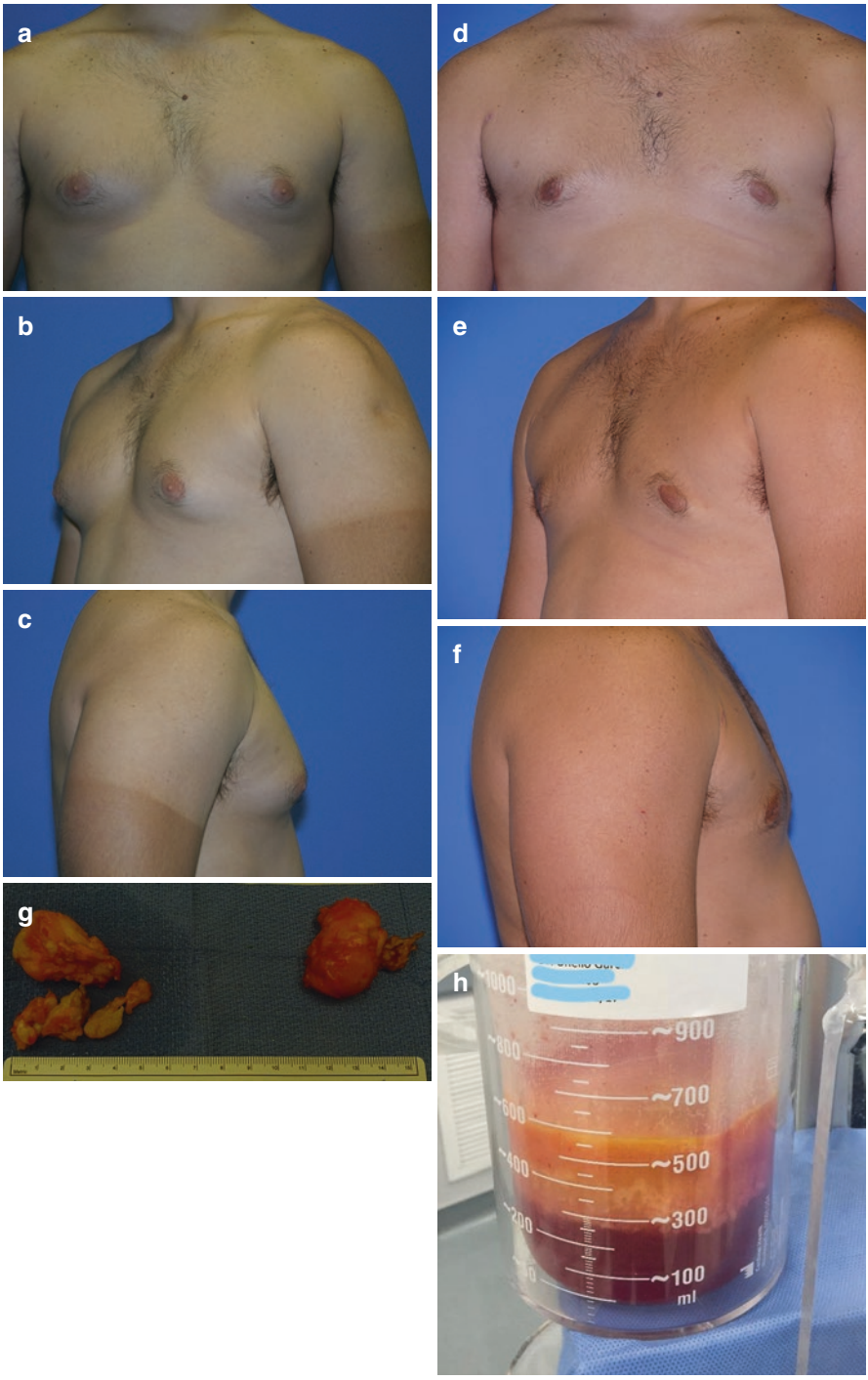

Fig. 7.4 (**a**–**f**) Surgical outcomes at 6 months of 26-year-old male post-VASER-assisted resection of bilateral gynecomastia. (**g**, **h**) Surgical specimen of fibro-glandular tissue and VASER aspirate

minute to a total of 800 ml per breast. A 3.7 mm, two-ring, VASER probe was employed at 90% energy level, in continuous mode for 4 minutes per breast. Aspiration was performed with a 3.7 mm VentX cannula for the deep tissue and a 3 mm VentX cannula for the superficial liposuction. Total aspirate consisted of 370 ml from right side and 300 ml from left side. The subareolar, fibro-glandular tissue was significant and could not be pulled through the 4 mm access incisions so an inferior areolar incision was used to access the tissue. Surgical outcomes at 1 year are depicted in Fig. 7.5a–f. Specimens and aspirate are depicted in Fig. 7.5g, h.

A 24-year-old athletic, healthy male is seen in consultation regarding painful, unilateral gynecomastia of his left breast. VASER-assisted liposuction of the left chest with extraction of the subareolar, fibro-glandular tissue with the "pull-through" technique was recommended. The outpatient surgery was performed under general anesthesia. The author's wetting solution formula for general anesthesia was infused at 300 ml per minute up to a total of 600 ml. A 3.7 mm, two-ring, VASER probe was utilized at 80% energy level for 3 minutes in continuous mode. Aspiration was performed with a 3.7 mm VentX cannula for the deeper tissues and a 3.0 mm VentX cannula for the superficial liposuction. Approximately 300 ml of fat was extracted from the left chest followed by extraction of the glandular tissue with the "pull-through" technique. Surgical outcomes at 1 month are depicted in Fig. 7.6a–f. Tissue specimen and aspirate are depicted in Fig. 7.6g, h.

A 26-year-old male body builder presents at consultation with a 4-year history of painful, bilateral gynecomastia following several cycles of anabolic steroid injections. VASER-assisted liposuction with "pull-through" resection of the fibro-glandular tissue was recommended. Although the patient wanted a decrease in his breast volume and relief of the associated discomfort, he desired to maintain an athletic appearing chest contour. The surgery was performed under general anesthesia as an outpatient procedure. The author's wetting solution formula for general anesthesia was infused at 300 ml per minute to a total of 800 ml to each side. A 3.7 mm, two-ring VASER probe was employed at 90% energy in continuous mode for 3 minutes per side. Aspiration was performed with 3.7 mm VentX cannulas for the deep tissue and 3.0 mm VentX cannulas for the superficial liposuction. Total supernatant fat aspirate was approximately 280 ml from each side. The surgical outcomes at 6 months are depicted in Fig. 7.7a–f. The subareolar fibro-glandular tissue and VASER fat aspirate are depicted in Fig. 7.7g, h.

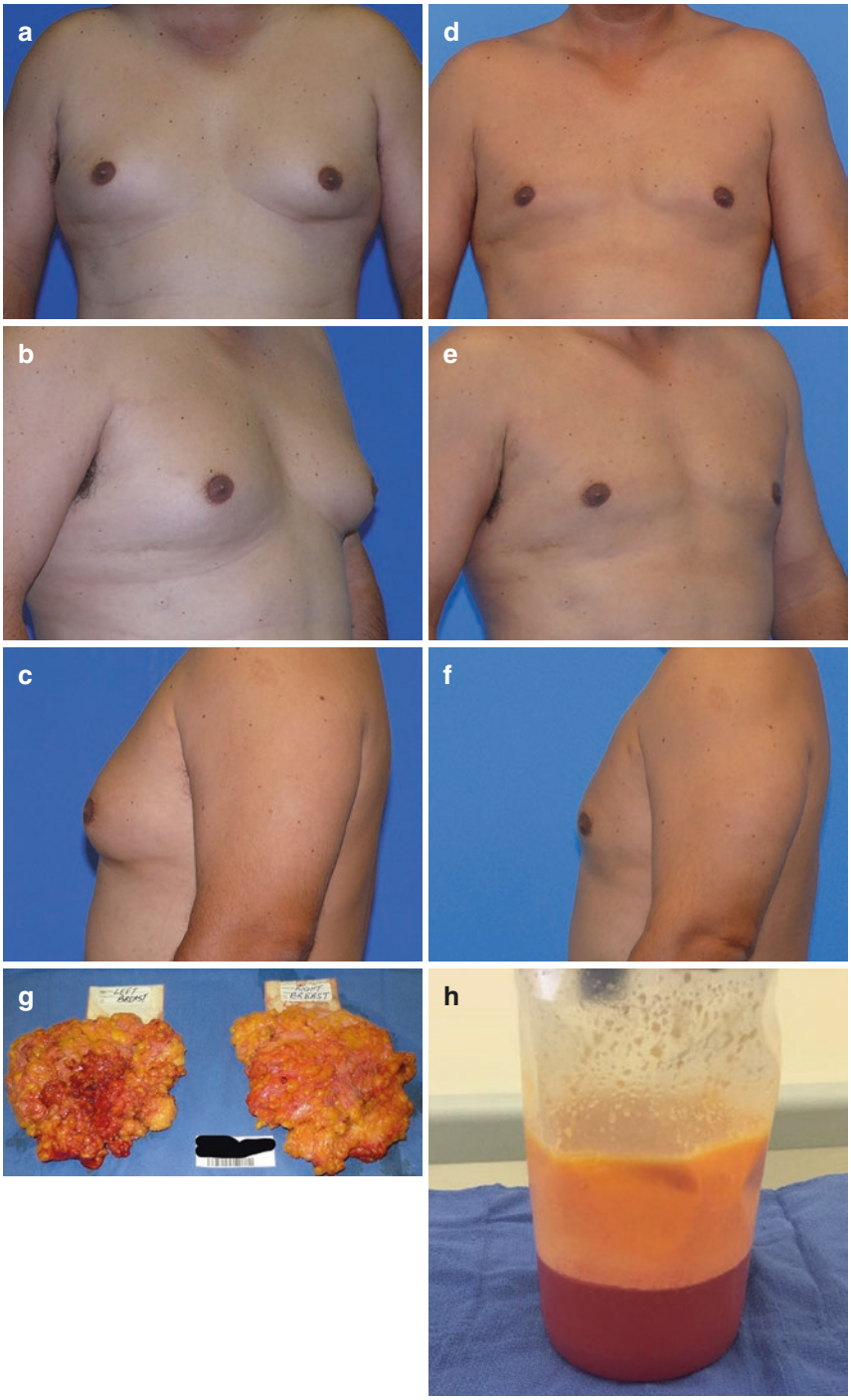

Fig. 7.5 (**a**–**f**) Surgical outcomes at 1 year of 44-year-old male post-VASER-assisted resection of bilateral gynecomastia. (**g**, **h**) Surgical specimen of fibro-glandular tissue and VASER aspirate

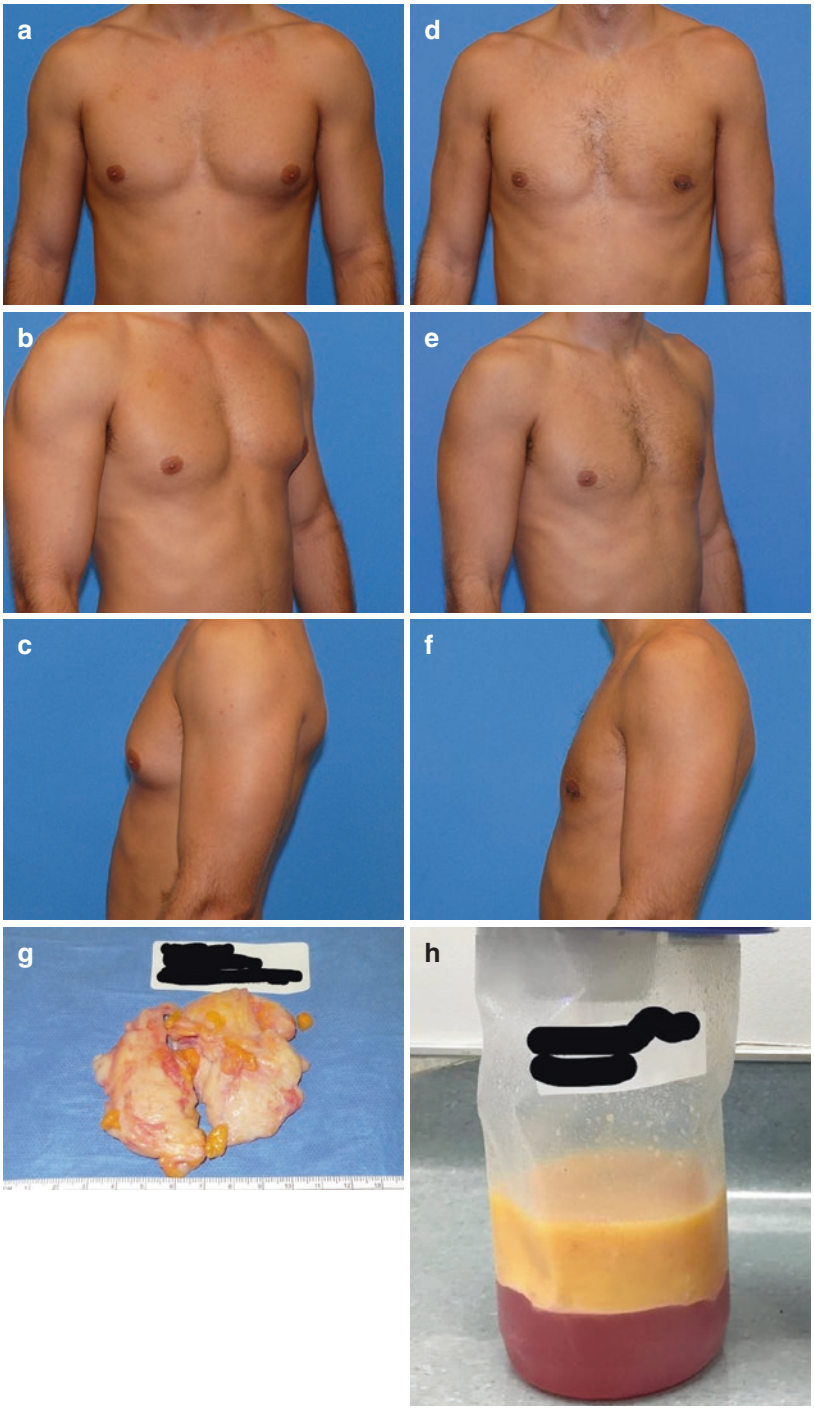

Fig. 7.6 (**a**–**f**) Surgical outcomes at 1 month of 24-year-old male post-VASER-assisted resection of unilateral left-sided gynecomastia. (**g**, **h**) Surgical specimen of fibro-glandular tissue and VASER aspirate

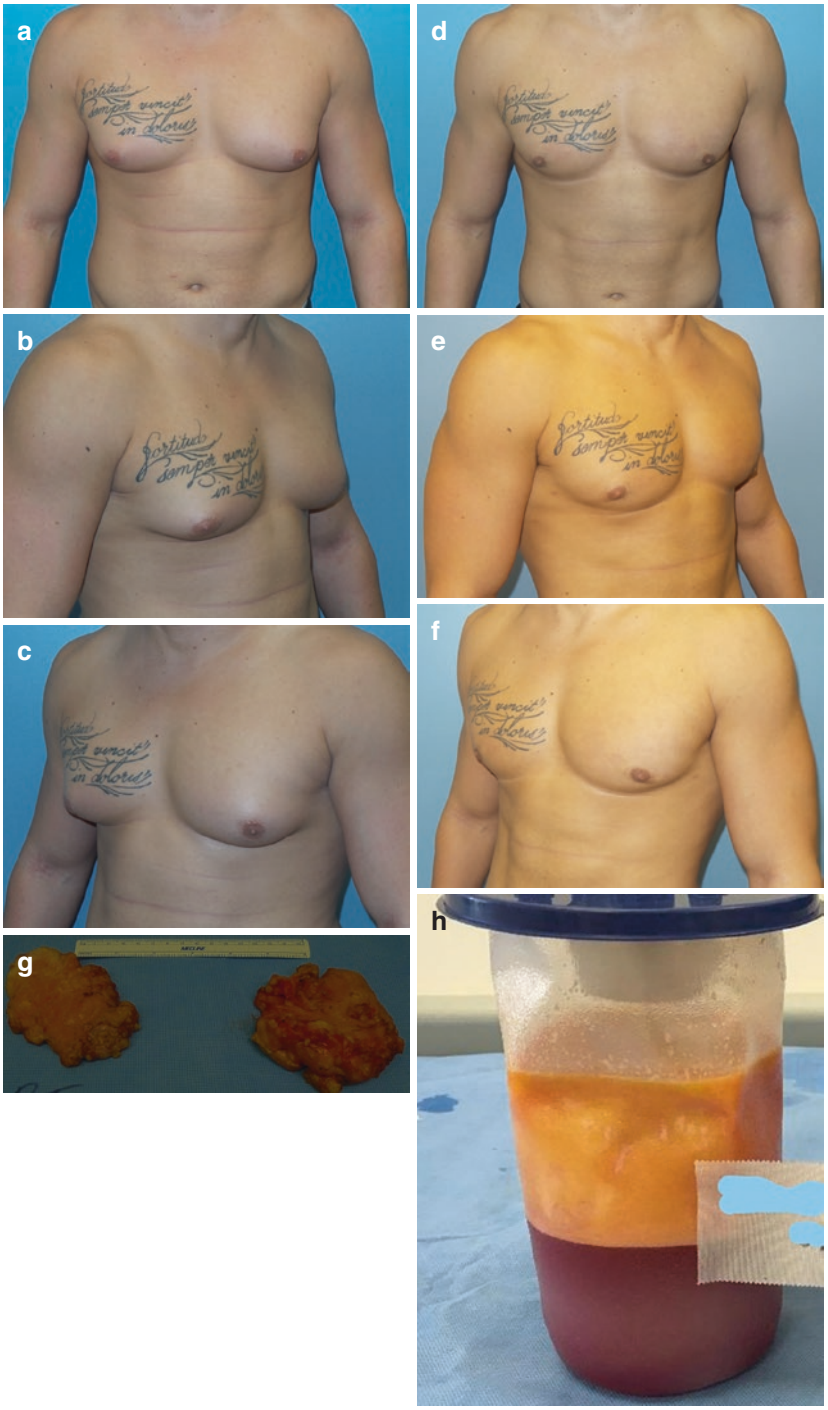

Fig. 7.7 (**a**–**f**) Surgical outcomes at 6 months of 26-year-old male post-VASER-assisted resection of bilateral gynecomastia. (**g**, **h**) Surgical specimen of fibro-glandular tissue and VASER aspirate

Conclusions

The author's preferred method for correction of gynecomastia in cases without skin resection involves VASER-assisted liposuction in combination with resection of the gland by means of a modified pull-through technique. This has been found to be a safe and efficient approach for the treatment of gynecomastia. This method is associated with highly favorable aesthetic results and relatively minimal postoperative downtime.

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Chapter 8
Contouring of the Extremities

Onelio Garcia Jr.

The trunk is the most frequent anatomical area for which patients seek liposuction; however in the author's experience, approximately 40% of liposuction cases involve the extremities, either by themselves or in combination with other anatomical areas. The typical areas of lipodystrophy in the extremities present body contouring challenges not usually encountered in the trunk. The extremities are three-dimensional, cylindrical structures that exhibit an uneven distribution of compartmentalized fatty deposits. It is generally agreed that circumferential liposuction of the extremities, either with traditional suction-assisted lipectomy (SAL) or VASER-assisted liposuction (VAL), yields a better aesthetic result than "spot liposuction."

Third-generation ultrasound for body contouring (VASER) was introduced to the field of liposuction in 2001. Since then, the device has undergone several upgrades and it is currently considered the "state of the art" in ultrasonic liposuction. The device is capable of rapid fat emulsification while delivering significantly less ultrasound energy to the tissues than previous generation ultrasonic liposuction devices [1]. Delivery of high ultrasound energy to the tissues has been implicated as the main source of ultrasound-assisted liposuction (UAL) complications associated with the earlier generations of UAL devices. Numerous studies have since reported improved aesthetic results with lower complication rates and minimal blood loss with the use of VASER [2–4]. The author has performed thousands of liposuction cases over the past 33 years. However for the past 16 years liposuction cases have been performed using VAL, due to the low complication rates, minimal blood loss, and greater ease of performing fine and detailed sculpting.

Rohrich, Beran, and Kenkel assessed the efficacy of UAL compared with SAL for multiple anatomical sites [5]. They rated the efficacy of UAL as good to excellent for the thighs and arms, fair to good for the calves, and fair to ineffective for the ankles. In the author's experience, the efficacy of VAL for contouring of the arms, thighs, and calves is rated as excellent. The overall experience with any type of UAL on the calves is poor; therefore it is suggested that UAL not be used in this particular area.

O. Garcia Jr. (✉)
Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

O. Garcia Jr. (ed.), *Ultrasound-Assisted Liposuction*,
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Preoperative Considerations

The great majority of the liposuction of the lower extremities is performed on female patients. The typical areas of lower extremity lipodystrophy in women are the superior, lateral thighs, or the so-called saddlebag deformity (the area inferior to the lateral gluteal depression and superior to the iliotibial tract), the infra-gluteal area, "banana roll deformity" (the area that extends from the inferior gluteal fold to the posterior thigh zone of adherence and blends laterally with the superior lateral thigh), and the superior medial thighs (the area that extends from the medial groin crease to the mid-medial thigh zone of adherence). In order to achieve a more harmonious and feminine result, it is important not to dissociate the thighs from the hips and buttocks in addition to a circumferential contouring approach. Recently, Vartanian et al. reported on the ideal thigh [6], a study based on crowdsourcing assessment of the aesthetically ideal thigh and its relationship to the hips and gluteal region. The study evaluated thigh-buttock aesthetics from the lateral and posterior views. From the lateral view the lateral thigh to buttock ratio was evaluated. Measurement "a" consisted of the horizontal distance across the buttock-thigh junction at the level of the gluteal crease and measurement "b" consisted of the horizontal distance from the anterior thigh to the point of maximum gluteal projection. Using these measurements, the lateral thigh-to-buttock ratio that was found most attractive by the study respondents was 0.8 followed closely by 0.6 as the second most attractive. From the posterior view, the thigh-buttock junction angle was represented by angle 0, the angle between an anatomical vertical, meridian from the anterior superior iliac spine to trochanteric crest, transposed laterally to intersect the thigh-buttock convexity and an oblique line from the widest point of buttock projection to the thigh-buttock junction. The study respondents chose the posterior view, thigh-buttock junction angle of 170° as the most aesthetically pleasing, and an angle of 155° as the second most attractive. What all this means is that overall, respondents chose a wider thigh base in relation to the buttock width as the most attractive thigh shape. This study included a total of over 1000 responses almost evenly split between male and female, representing all adult age groups and multiple ethnicities. According to Ali [7], these findings represent a paradigm shift from the traditional assumed preference for slender thighs. Plastic surgeons should consider the aesthetic preferences of the public at large and most importantly avoid dissociation between the thighs, hips, and buttocks during body contouring procedures.

There are five zones of adherence in the thighs and these are areas that should be avoided during liposuction procedures: (1) the gluteal crease, (2) the posterior distal thigh above the popliteal crease, (3) the lower lateral thigh area of the iliotibial tract, (4) the lateral gluteal depression, and (5) the mid-medial thigh area. Violating these areas with either ultrasonic probes or aspiration cannulas can often lead to contour deformities. Some experienced body contouring surgeons occasionally make an exception to the zones of adherence in relation to the mid-medial thigh. In patients with significant fat lipodystrophy the author often achieves improved aesthetic results by performing judicious fat aspiration in the mid-medial thigh area in order to blend the superior medial thigh with the medial knee area. Typical preoperative markings for thigh liposuction are depicted in Fig. 8.1a–d; the zones of adherence are marked in red and the areas for liposuction are marked in green.

For the purpose of planning contouring procedures in the upper extremity, Gilliland and Lyos [8] conceptually divided the arm into three regions: anteromedial, anterolateral, and posterolateral. The majority of the lipodystrophy in the upper extremity occurs in the posterolateral area of the arm. A small amount of fat is present in the anterolateral region and there is minimal fat in the anteromedial region. The great majority of upper extremity liposuction is performed in the posterolateral and anterolateral regions. Liposuction in the anteromedial region should be avoided in most cases since a pinch test in this region frequently is less than 1 cm and extracting fat in this area commonly results in contour irregularities.

Both the ultrasound probes and the cannulas are passed longitudinally along the long axis of the arm. Liposuction access incisions, particularly with VAL or UAL,

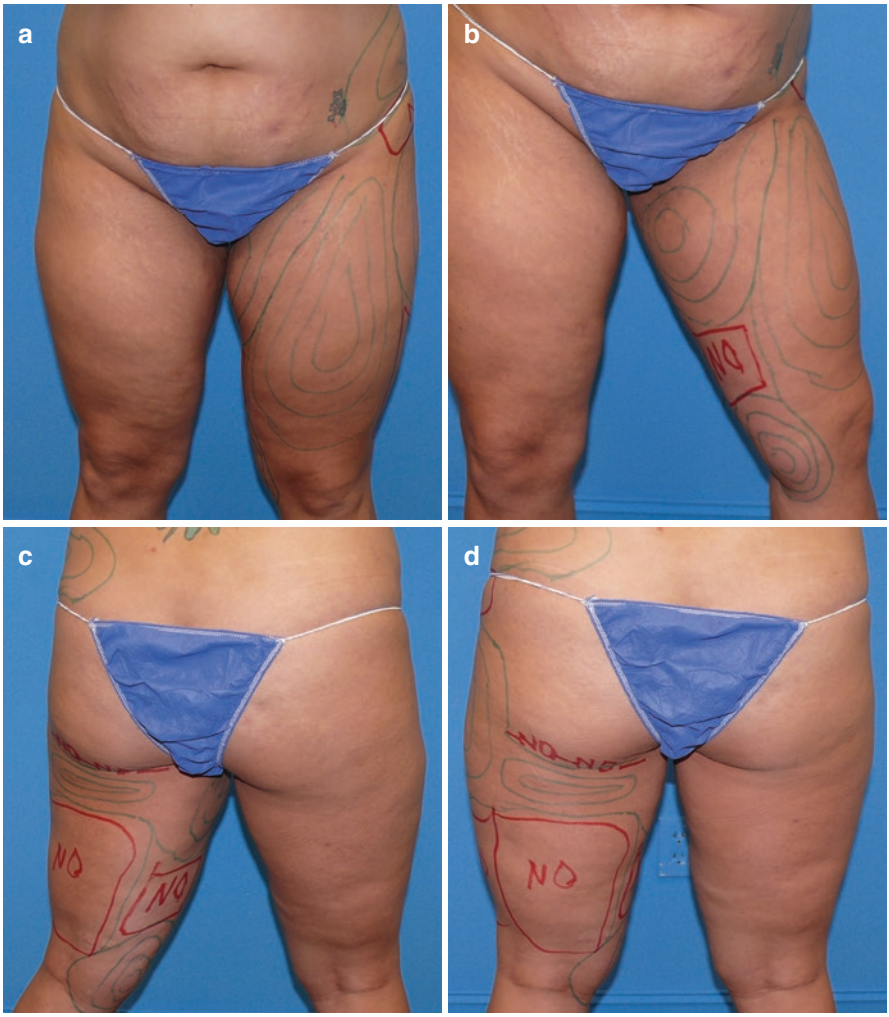

Fig. 8.1 (**a**–**e**) Preoperative markings, lower extremities. Zones of adherence are marked in red

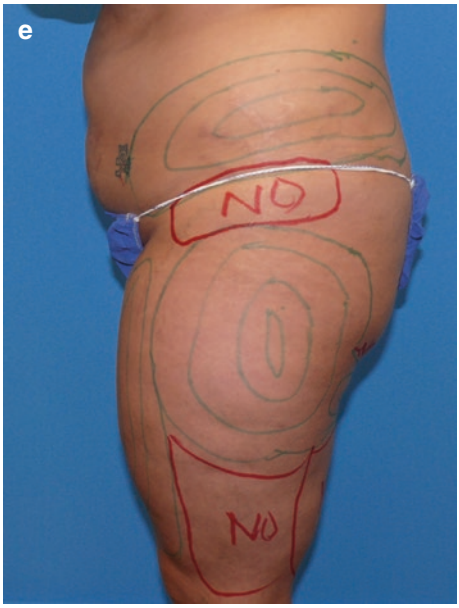

Fig. 8.1 (continued)

should be placed in the posterior axillary fold and the radial aspect of the elbow to avoid injury to the ulnar nerve. When the ultrasound probe is inserted proximally through the axillary access incision, the surgeon should avoid moving the tip of the probe in the ulnar aspect of the elbow. When the probe is inserted distally through the radial aspect of the elbow, the surgeon should avoid moving the tip of the probe into the axilla. Typical preoperative markings for arm liposuction are depicted in Fig. 8.2a, b, with the areas of liposuction in green and areas to be avoided in red.

Indications

One of the most important considerations for liposuction has always been patient selection. In the early days of traditional liposuction, plastic surgeons learned that in order to consistently achieve good aesthetic results and avoid complications with the technique, they would have to adhere to strict patient selection criteria. Back then the strict criteria consisted of relatively young, healthy patients, close to their ideal body weight and with well defined, localized areas of lipodystrophy. With the advent of the third-generation ultrasound devices (VAL), plastic surgeons have been able to expand the patient selection criteria for these procedures. Using VAL, the author frequently performs high-volume liposuction on healthy but overweight patients with poorly defined areas of lipodystrophy and moderate skin tone. A useful patient selection criteria for thigh contouring are depicted in Table 8.1.

Individuals who are close to their ideal body weight and have a disproportionately high distribution of fat in the lower extremities in relation to their trunk are still the best candidates for thigh liposuction. The fat in the upper medial thigh is soft, relatively loose,

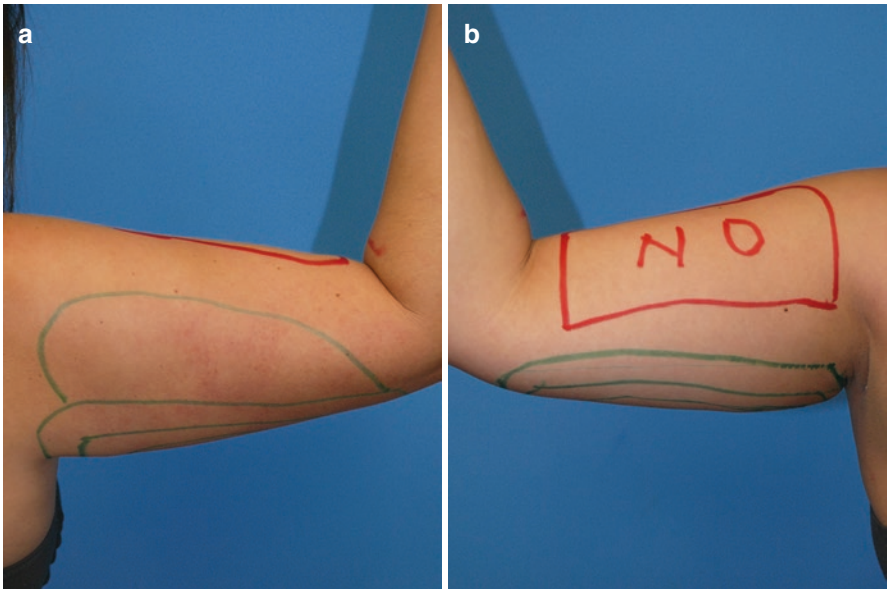

Fig. 8.2 (**a**, **b**) Preoperative markings, upper extremities. Areas marked in red should be avoided

Table 8.1 Thigh contouring: patient selection criteria

Type	Skin tone	Degree of lipodystrophy	Recommendations
I.	Good skin tone	Moderate	VAL, UAL, or SAL
II.	Moderate laxity	Moderate	VAL or UAL
III.	Moderate laxity	Minimal	Thighplasty
IV.	Significant laxity	Moderate to large	VAL-thighplasty

VAL VASER-assisted liposuction, *UAL* ultrasound-assisted liposuction, *SAL* suction-assisted lipectomy

and covered by very thin dermis as opposed to upper lateral thigh fat which is dense, relatively fibrous, and covered by thicker dermis. These anatomical differences make the upper lateral thigh a relatively forgiving area for contouring with liposuction as opposed to the upper inner thigh which is quite unforgiving. Poor patient selection and overextraction resulting in excessive skin laxity and contour deformities are the most common causes of inferior aesthetic results following contouring of the thighs. Definitely any type of liposuction procedure of the medial thighs (either SAL or VAL) should be avoided in patients with significant skin laxity or minimal fat distribution in the area (pinch test of less than 2 cm). An excisional procedure such as a thighplasty is recommended for those patients. In patients with skin laxity and significant fatty deposits in the thigh, the author frequently performs a VASER-assisted thighplasty. This procedure is ideal for large thighs with loose skin since it limits the tissue undermining, diminishes the empty space, and preserves the majority of the lymphatic drainage. This technique has significantly reduced the seroma formation and wound healing complications that were associated with procedures that employed open resection and wide tissue undermining.

Classifications that have been proposed for the preoperative planning of upper extremity contouring all have one thing in common: a comparison of the relationship between the excess arm fat and the skin envelope of the arm. Poor skin tone,

Table 8.2 Arm contouring: patient selection criteria

Type	Skin tone	Degree of lipodystrophy	Recommendations
I.	Good skin tone	Moderate	VAL, UAL, or SAL
II.	Moderate laxity	Moderate	VAL or UAL
III.	Moderate laxity	Minimal	Brachioplasty
IV.	Significant laxity	Moderate to large	VAL-brachioplasty

VAL VASER-assisted liposuction, *UAL* ultrasound-assisted liposuction, *SAL* suction-assisted lipectomy

regardless of the amount of arm fat, usually dictates that an open tightening procedure be performed in order to properly contour the arm. Patients with poor skin tone and a significant amount of excess arm fat are best treated by a VASER-assisted brachioplasty. This is a highly efficient method of arm contouring which yields good aesthetic results with low complications. There is a significant decrease in the diameter of the arm following extraction of the fat using VAL and the excess skin envelope is then resected without tissue undermining, avoiding empty spaces. Because the arm dermis is relatively thin, VAL has the advantage over UAL of smaller-diameter ultrasound probes that achieve proper fat tissue emulsification while delivering significantly lower ultrasound energy to the tissues [9]. Patient selection criteria for arm contouring mirror that of thigh contouring and are depicted in Table 8.2.

Patient Evaluation

The patient selection criteria have expanded over the years particularly since the advent of VAL; however one criterion that remains unchanged in patient selection is the health status of the prospective patient. As with any elective, aesthetic procedure, liposuction should be reserved for healthy individuals in relatively good physical condition. It is of paramount importance that from a psychological point of view, the prospective patient is capable of understanding the limitations of the surgery and can establish realistic expectations regarding the expected outcome. Once the patient meets the physical and psychological requirements for undergoing elective, aesthetic surgery, the plastic surgeon can then determine if they are a suitable candidate for liposuction. The most important factors to be evaluated in the particular anatomical area being considered for contouring are the amount of excess fat present and the condition of its overlying skin envelope.

Prospective patients are evaluated in the standing position. The upper extremities are evaluated with the arm abducted 90° from the shoulder and the elbows flexed 90°. Lower extremities are evaluated from the anterior, posterior, lateral, and oblique views. Most important to note are the degree of lipodystrophy and the quality of the overlying skin. Also important to note as part of the evaluation process is the presence of cellulite, striae, varicose veins, telangiectasias, contour deformities, and asymmetries. For many years it was useful to document all the findings on a body contouring data sheet with body diagrams which could then be used to discuss with the patient. Currently the author uses a TouchMD system which allows the documentation of the findings to be marked directly on the patient's high-definition pho-

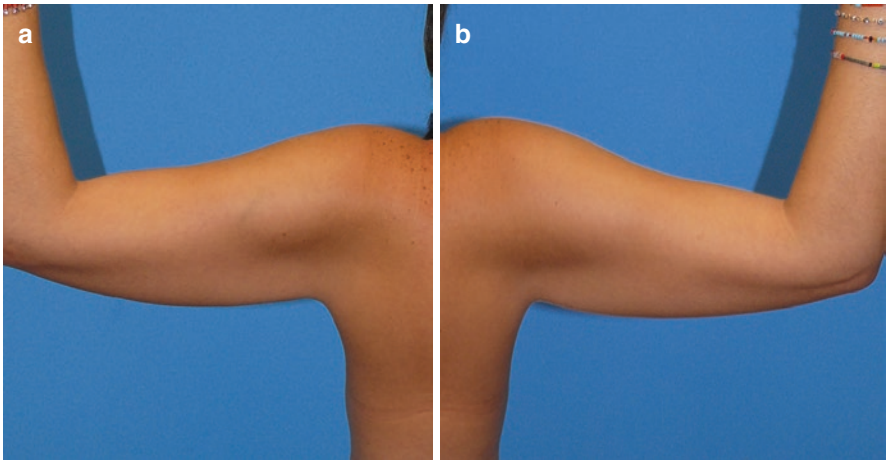

Fig. 8.3 (**a**, **b**) Preoperative photography upper extremities

tographs on a smart screen. After reviewing this on the large screen with the patient, they are given a password that allows them access from their home computer to their personal electronic photo file with their preoperative photos and markings. The author has found this technology to be an invaluable asset to the body contouring consultation process since it allows the patient to revisit their consultation from the comfort of their own home. In the author's experience, over 95% of the prospective patients log in from home to review their photo files preoperatively and these patients tend to be typically much better informed about the procedure they are considering. Preoperative photos are stored in the system so that they can be accurately compared to the interim and final postoperative photos. The arms are photographed with the arm abducted from the shoulder 90° and the elbows flexed 90° in the anterior and posterior view (Fig. 8.3a, b). The lower extremities are photographed in the anterior, posterior, lateral, anterior oblique, and posterior oblique views (Fig. 8.4a–h). Typically, the surgeon reviews the preoperative photos with the patient prior to the surgery and points out and marks any contour irregularities or asymmetries that may be present. A photograph of the preoperative markings is useful as a record of the extent of the liposuction and the particular areas included in the contouring.

Planning and Preparation

When planning body contouring procedures, consistent photographic standards are of paramount importance. In order to ensure accurate preoperative and postoperative photographic comparisons, it is important to pay attention to details such as focal distances, positioning, lighting, and backdrops.

The proper procedure for informed consent requires that the patient is provided enough pertinent information about the proposed surgery in a manner that allows them to make an informed decision about the surgery. In addition to the universal

risks of undergoing surgery under anesthesia, patients are informed of surgical risks pertinent to SAL and VAL: contour deformities or asymmetry necessitating secondary revisionary surgery, infection, bleeding, scarring, skin discoloration, sensory changes, seroma, fluid overload (pulmonary edema), severe dehydration (hypovolemic shock), chronic pain, peritoneal perforation with injury to deep structures, and possible skin and soft tissue burns as a result of UAL or VAL. Fortunately, major complications are rare in liposuction and the most common typically consist of

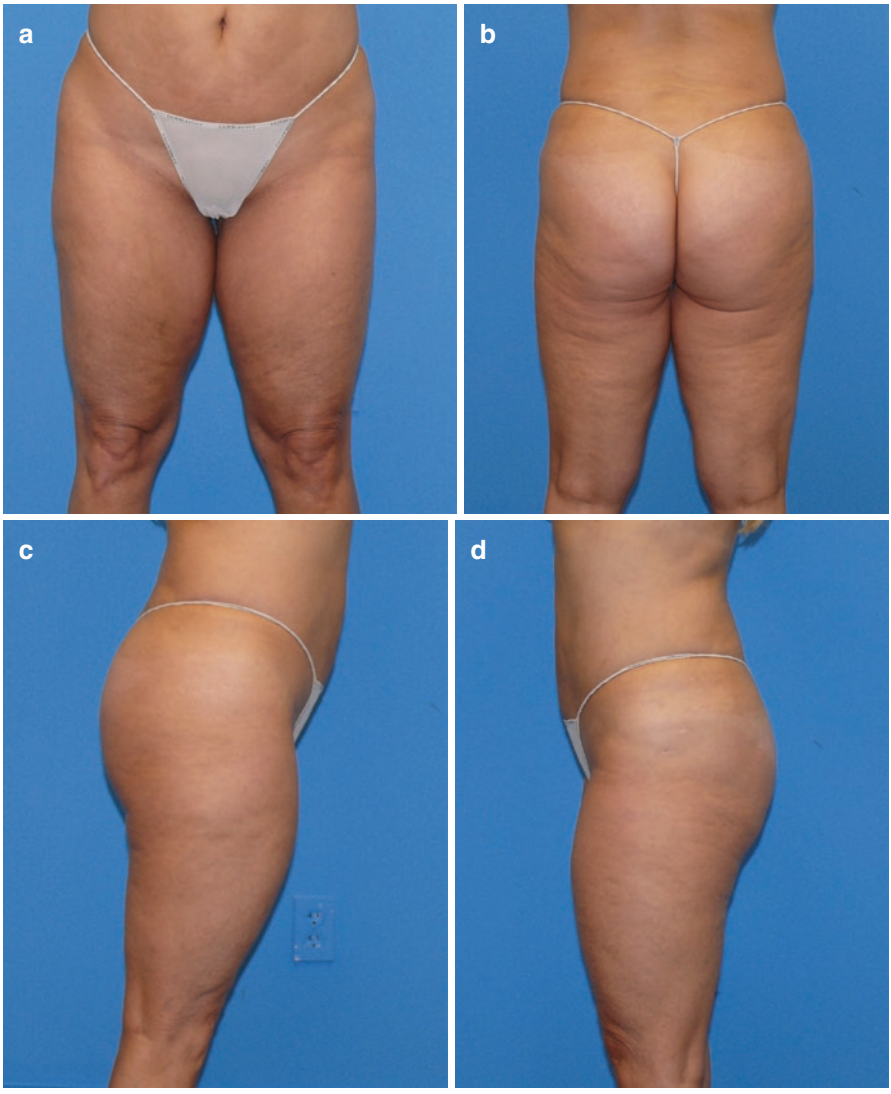

Fig. 8.4 (**a**–**h**) Preoperative photography lower extremities

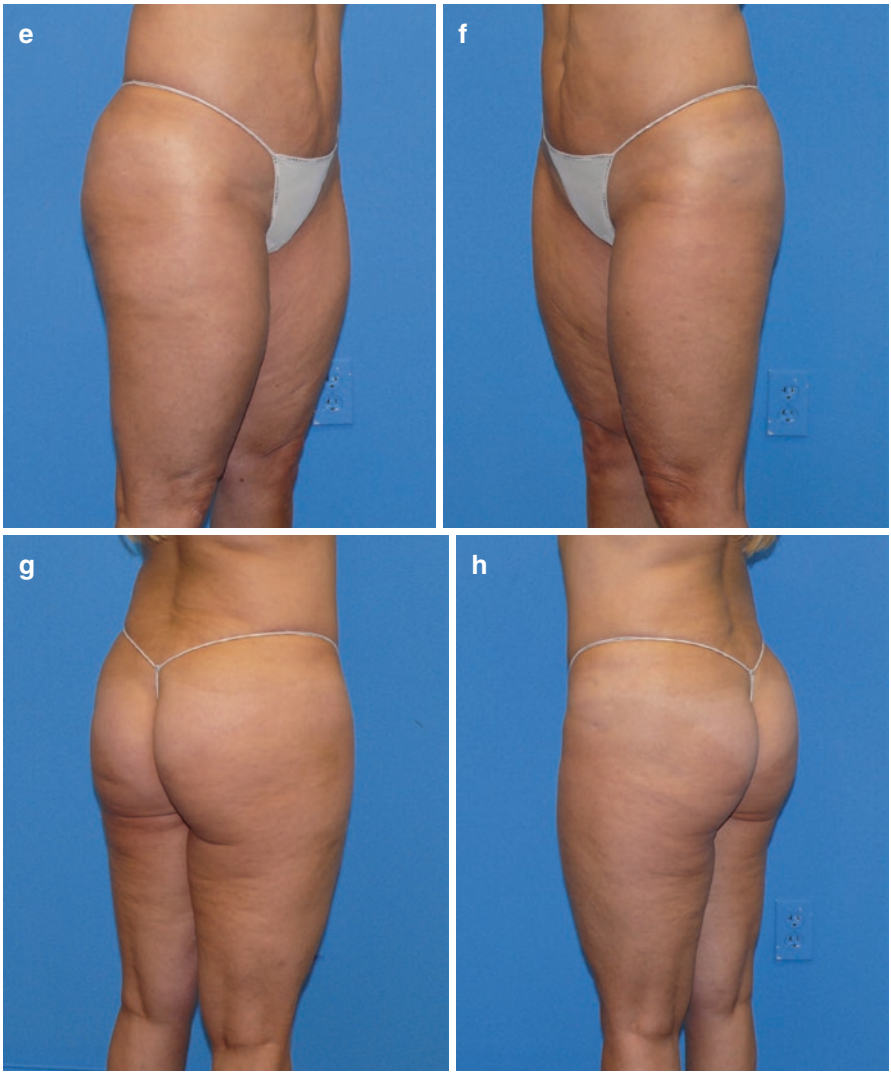

Fig. 8.4 (continued)

minor contour deformities and asymmetries. As expected, the complication rate is higher in high-volume liposuction cases.

Prospective patients considering liposuction should undergo an extensive consultation that includes a thorough medical history and physical examination. It is important to discontinue any medications which may affect clotting mechanisms or platelet function in advance of the surgery. It is also important to examine for any risk factors that could potentially lead to deep vein thrombosis (DVT) and possibly progress to pulmonary emboli (PE). A survey of members of the American Society

for Aesthetic Plastic Surgery (ASAPS) by Grazer and de Jong [10] reported a mortality rate of 19/100,000 for patients undergoing liposuction with approximately 25% of the deaths being the direct result of PE. Temourian and Rogers reported on more than 75,000 major liposuction procedures and found the incidence of DVT to be 33/100,000 and confirmed diagnosis of PE to be 12/100,000 [11]. Sequential pneumatic compression devices should be part of the routine protocol for major liposuction procedures. Although the protocol for patients at high risk for DVT during excisional body contouring procedures should include prophylactic doses of low molecular weight heparin, many plastic surgeons do not use pharmacologic prophylaxis for routine liposuction procedures mainly because of the increased risks of bleeding complications and excessive postoperative bruising. Liposuction patients are seldom immobile in the same position since they are frequently turned to different positions on the operating table during the surgery. These procedures are also associated with early postoperative ambulation and the patients are also encouraged to continue ambulate frequently during the first 2–3 weeks after surgery.

Surgical Technique

Whenever possible, it is the author's preference to perform the preoperative markings in the office the day prior to surgery. The markings are performed with waterproof markers, are photographed, and are reviewed with the patient while pointing out asymmetries or contour irregularities that may be present preoperatively. This procedure helps the patient have a better understanding of the surgical plan and avoids misunderstandings regarding the extent of the planned contouring or the placement of the incisions. During the preoperative marking session the surgeon must pay close attention to the placement of the access incisions since ultrasonic liposuction surgery requires a greater number of access incisions of slightly longer length to accommodate the skin protectors. It is imperative that the ultrasound probes have direct lineal access to the treatment areas since the probes do not bend and the surgeon should avoid placing torque on the probes.

The author performs the majority of the major liposuctions under general anesthesia using a wetting solution that consists of 1 ml of epinephrine 1:1000 added to a liter of Ringer's lactate solution at room temperature [12]. Omitting lidocaine from the wetting solution in high-volume liposuction safely allows for high-volume infiltrations of the solution without the concern of lidocaine toxicity. Both UAL and VAL should be performed with high amounts of wetting solution well dispersed throughout the tissues. Ultrasonic liposuctions involving smaller surface areas can be safely performed under local tumescent anesthesia. In these cases, the author adds 30 ml of 1% lidocaine to each liter of his standard wetting solution. The safest recommendation regarding the use of lidocaine in liposuction is to not exceed 35 mg/kg although some authors have reported on the routine use of lidocaine doses exceeding 50 mg/kg without complications [13].

Mild hypothermia in major liposuction cases is a common occurrence as a result of a number of factors encountered during the surgery such as large body surface areas exposed, large volume of wetting solution dispersed within the subcutaneous space, and thermoregulatory changes induced by prolonged general anesthesia. Employing a Bair Hugger over the head and all other nonoperative areas while using a fluid warmer for the intravenous fluids is helpful in maintaining core body temperature and is an efficient method for combating hypothermia in liposuction patients.

It was once common to cover the operating table with sterile sheets and have the patient stand for the prepping which would be performed with povidone-iodine (Betadine) solution in a circumferential fashion. The patient would then lie on the sterile, draped operating table and the rest of the draping completed. Currently the preference of many plastic surgeons (including the author) is to prep and drape the patient already in the proper surgical position and under anesthesia. Betadine gel is the preferred prep. Appropriate access for circumferential VAL of the lower extremities requires repositioning of the patient on the operating table.

The author performs all the lower extremity liposuctions in the supine and lateral decubitus positions (Fig. 8.5a, b). The supine-to-right lateral-to-left lateral-to-supine requires an additional turn and repositioning over the supine-to-prone-to-supine positions; however it is chosen for UAL and VAL cases because it provides direct lineal access to the treatment areas for the ultrasound probes. The supine position provides direct access to the anterior thighs, medial thighs, and knees. The lateral decubitus position provides access to the upper, lateral thighs, and infragluteal area. When extracting large volumes from the hips and flanks, the lateral decubitus position helps to avoid "end hits" where the tip of the probe or cannula is forced into the deep dermis.

Access incisions for UAL or VAL should be of sufficient length to accommodate the skin protectors. The wetting solution is infused at a rate of 400–500 ml/minute using a power infusion pump. The ultrasound energy is delivered to the medial knees and medial thighs by a five-ring, 3.7 mm diameter VASER probe (Solta

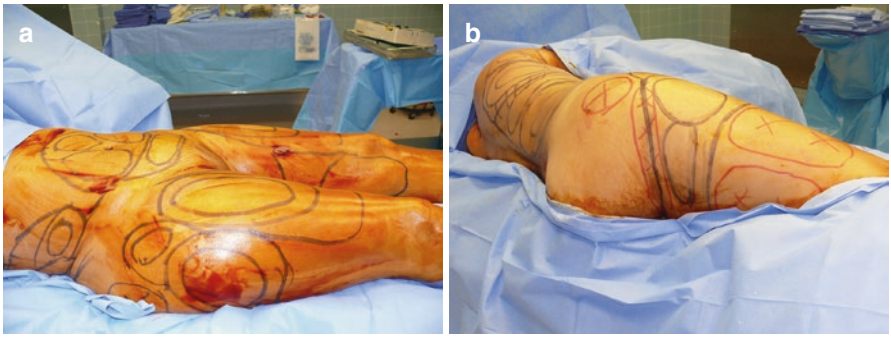

Fig. 8.5 (**a**, **b**) Supine and lateral decubitus positions for VAL contouring of the lower extremities

Medical, Bothell, WA) at 70% energy level in VASER (pulsed) mode. Total ultrasound time for medial thighs and knees should be approximately 45 seconds per 100 ml of expected aspirate from these areas [14]. Ultrasound application to the lateral thighs, anterior thighs, hips, and infra-gluteal areas is delivered with a 3.7 diameter 5-ring probe at 80% energy level in VASER (pulsed) mode. Ultrasound times for these areas are approximately 1 minute per 100 ml of expected aspirate. Contouring of the calves is not nearly as common as thigh contouring. In this area the author recommends using relatively high amounts of wetting solution, about a 4:1 ratio of solution to expected aspirate. A five-ring, 3 mm diameter probe is used at 60–70% energy level in VASER (pulsed) mode for 45 seconds for every 100 ml of expected aspirate.

The author's approach to arm contouring involves placing the patient in the supine position on the operating table with the elbow flexed 90° and stabilized on a surgically draped mayo stand at the head of the table (Fig. 8.6). The arm is circumferentially prepped to allow free movement. Access incisions are placed in the posterior axillary fold and the radial aspect of the elbow. Contouring of the arms with VAL can be efficiently accomplished with relatively low ultrasound energy delivered to the tissues. Using a power infusion pump, the wetting solution is evenly dispersed throughout the arm at the rate of 300 ml/minute. Five-ring, 3 mm diameter VASER probes are used with the energy settings at 70% VASER (pulsed) mode for 45 seconds for every 100 ml of expected aspirate.

It used to be commonplace during VAL procedures to deliver the ultrasound energy for 1 minute for every 100 ml of wetting solution infused. That formula may have been adequate when using a "superwet" technique with a 1:1 ratio of wetting solution to expected aspirate. However the current recommendation for VAL employs much higher volumes of wetting solution (at least 3:1 ratio of solution to

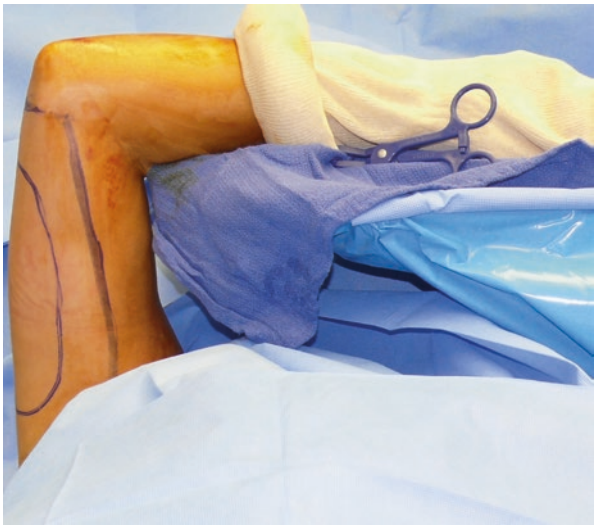

Fig. 8.6 Intraoperative positioning for VAL contouring of the upper extremity. The arm is circumferentially prepped to allow free movement

Table 8.3 VASER-assisted liposuction of the extremities: recommended ultrasound settings

Area	Energy (%)	Mode (V,C)	Probe	Exposure time
Arms	60–70	V	3.7 mm, 5-ring	45 seconds/100 ml expected aspirate
Medial knees	70	V	3.0 mm, 3-ring	45 seconds/100 ml expected aspirate
Medial thighs	60–70	V	3.7 mm, 5-ring	45 seconds/100 ml expected aspirate
Lateral thighs	70–80	V	3.7 mm, 5-ring	45–60 seconds/100 ml expected aspirate
Infra-gluteal	70–80	V	3.7 mm, 5-ring	45–60 seconds/100 ml expected aspirate
Hips	80	V	3.7 mm, 5-ring	60 seconds/100 ml expected aspirate

V VASER (pulsed) mode, *C* continuous mode

expected aspirate) and the previous formula would deliver a higher dose of ultrasound energy to the tissues than what would be necessary to achieve adequate fat fragmentation.

Fat aspiration from the lower extremities is performed with 3 mm and 3.7 mm VentX cannulas (Solta Medical, Bothell, WA) and for the arms the author employs a 3 mm VentX cannula. The emulsified VASER aspirate easily flows through small-diameter cannulas which provide a higher level of precision when contouring these areas than the larger-diameter cannulas. It is useful to leave behind about 5% of the fragmented fat. This loose, emulsified fat can be manually shifted in the treated area until it is smooth. This process of fat equalization has been described by Wall [15] as part of the SAFELipo technique. This technical maneuver is easily applied during VAL cases because the fatty emulsion of VAL aspirate is comprised of living fat cells that are suitable for fat grafting when harvested at clinically recommended energy settings. The maneuver is helpful for avoiding contour irregularities in areas with thin dermal cover such as the arm or inner thigh. The author's recommendations for VASER ultrasound settings for contouring the extremities are displayed in Table 8.3.

Surgical Outcomes

A 31-year-old nulliparous woman was seen in consultation regarding contouring of her abdomen, back, arms, hips, and thighs. She stands 5 feet 7 inches tall and weighs 162 pounds. The patient underwent circumferential VAL of her trunk, arms, and thighs under general anesthesia. The surgery was performed in a hospital environment. Following the high-volume VAL extraction, appropriate fluid management was performed overnight with intravenous crystalloids and an indwelling Foley catheter to monitor the urine output. The total aspirate volume was 10,500 ml with 7100 corresponding to the hips and thighs and 500 ml corresponding to the arms. Approximately 3000 ml of the lower extremity aspirate was supernatant fat.

The surgery was performed under general anesthesia and the positioning was lateral decubitus-to-lateral decubitus-to-supine. A total of 5400 ml of wetting solution consisting of 1 mg of epinephrine per liter of Ringer's lactate solution was infused into the extremities. A 3.7 mm, three-ring VASER probe in pulsed mode was used in the hips and lateral thighs at 80% energy level and 70% energy level for the inner thighs. The arms were treated with a 2.9 mm, three-ring probe at 70% energy level in pulsed mode, after infusion of 350 ml of wetting solution per arm. Aspiration was performed with 3.7 mm and 3.0 mm VentX cannulas and the access incisions closed with buried absorbable sutures. The patient was discharged home the day after surgery after an uneventful recovery. Surgical results at 1 year are displayed in Fig. 8.7a–h.

A 36-year-old physically fit woman was seen in consultation 1 year postpartum with residual fatty deposits of her abdomen, hips, and thighs. She stands 5 feet 6 inches tall, weighs 135 pounds, and has good skin tone with well-defined areas of lipodystrophy. She underwent circumferential VAL of her abdomen, hips, and thighs under general anesthesia as an outpatient. A total of 6 L of wetting solution consisting of 1 ml epinephrine 1:1000 in 1 L Ringer's lactate solution was evenly dispersed within the tissues of the mapped areas of the hips and thighs with a power-assisted infusion pump at a rate of 300 ml per minute. The hips were treated for 5 minutes each with a 3.7 mm, three-ring VASER probe at 80% energy level in pulsed mode. The inner thighs were treated for 3 minutes each using a 3.7 mm, three-ring VASER probe at 70% energy level in pulsed mode. All the aspiration was performed with 3 mm VentX cannulas. The total VAL aspirate for the surgery was 5200 ml. The hips and thighs accounted for 4450 ml of the total aspirate of which 3200 ml consisted of supernatant fat. Removal of the residual wetting solution through the access incisions was performed by rolling massage of the areas. The incisions were closed with buried absorbable sutures. A compression garment over TopiFoam covering the treated areas was employed postoperatively. The surgical results at 9 months are depicted in Fig. 8.8a–f.

A 38-year-old multiparous woman was seen in consultation regarding lipodystrophy of her abdomen hips and thighs. She stands 5 feet 4 inches tall, weighs 142 pounds, and has moderate skin tone. The physical exam of these areas also revealed a concave contour deformity in her lower abdomen from a previous abdominal laser-assisted liposuction. Her surgery involved outpatient circumferential VAL of her trunk, hips, and thighs under general anesthesia. Correction of the lower abdominal deformity was performed with VASER ultrasound release and fat grafting. The total wetting solution volume employed was 8 L of the author's formula (1 mg epinephrine 1/1000 in a liter of Ringer's lactate) infused at 400 ml/minute with a power infusion pump. A 3.7 mm, three-ring VASER probe was used at 80% energy level in pulsed mode in the trunk and outer thighs. The inner thighs were treated at 70% pulsed mode. Aspiration was performed with 3.7 mm and 3.0 mm VentX cannulas. The total VAL aspirate volume for the surgery was 6800 ml of which 4700 ml cor-

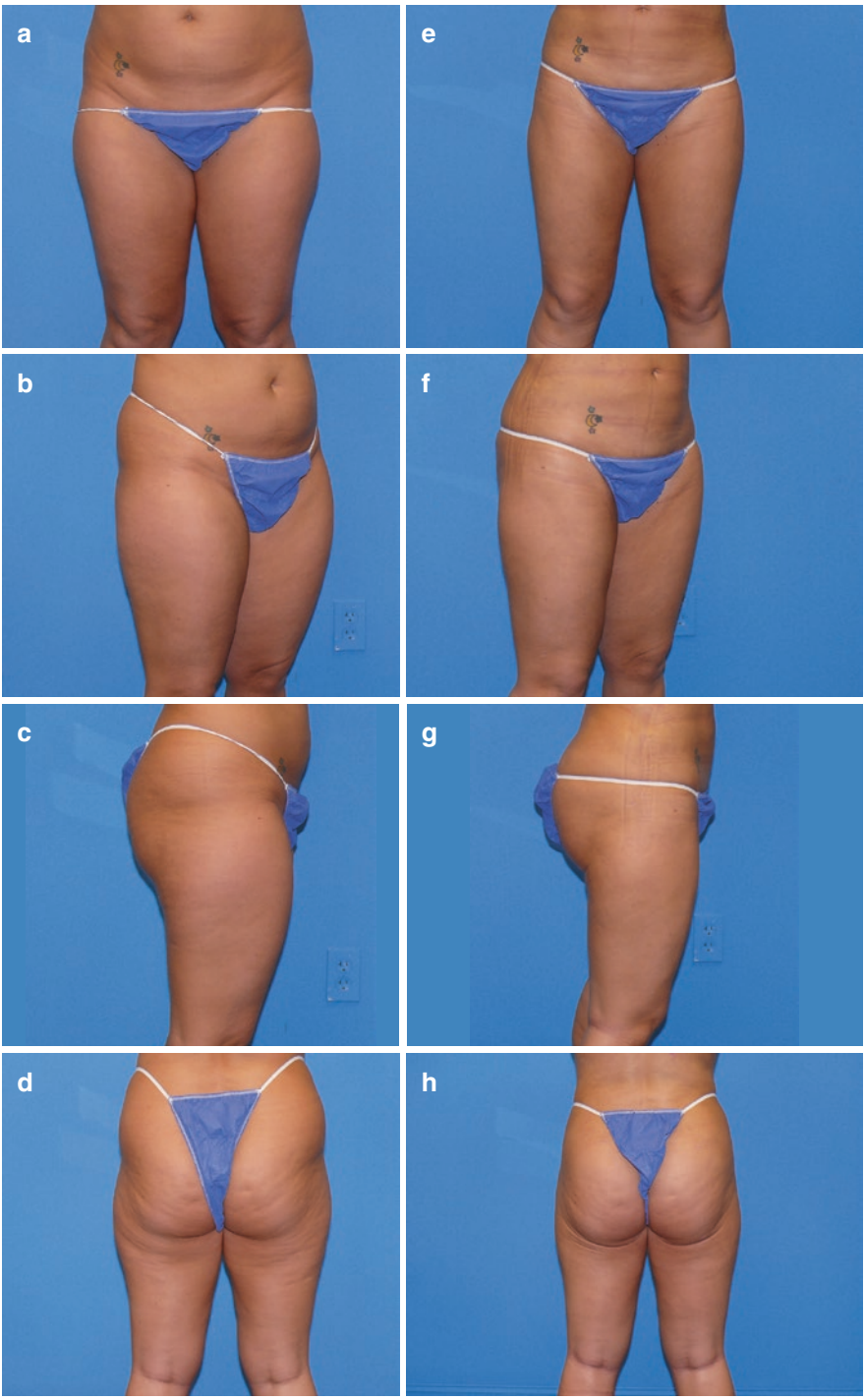

Fig. 8.7 (**a**–**h**) A 31-year-old woman 1 year post-circumferential VAL of her trunk and thighs

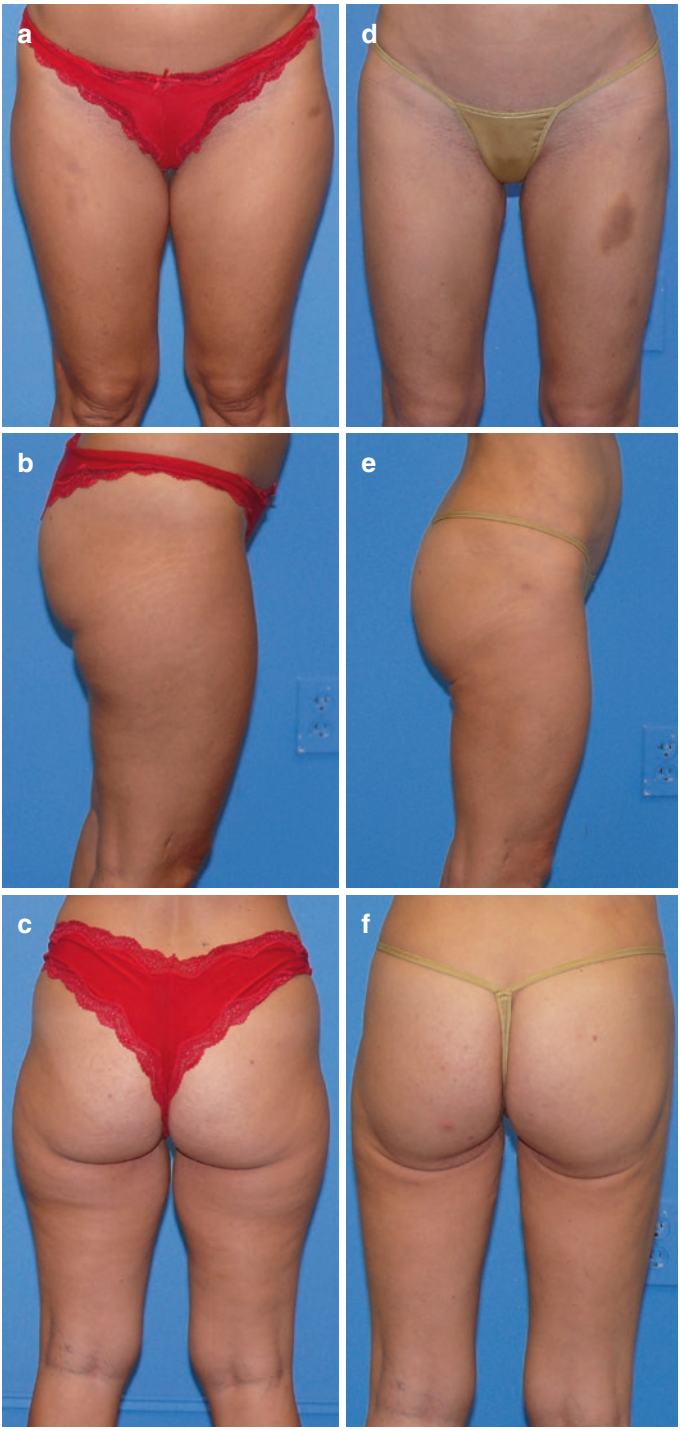

Fig. 8.8 (**a**–**f**) A 36-year-old woman 9 months post-circumferential VAL of her trunk and thighs

responded to the hips and thighs. A total of 1300 ml of supernatant fat was extracted from each lower extremity. Surgical results 6 months post-surgery are displayed in Fig. 8.9a–d.

A 38-year-old woman was seen in consultation regarding lipodystrophy of her arms. The upper extremity skin tone is moderate; however the patient did not wish to undergo an open brachioplasty procedure and was willing to accept partial fat evacuation with limited improvement. She underwent circumferential VAL of her arms under general anesthesia as an outpatient procedure. A total of 500 ml of the author's wetting solution was infused into each arm per an infusion pump at 250 ml/minute. A

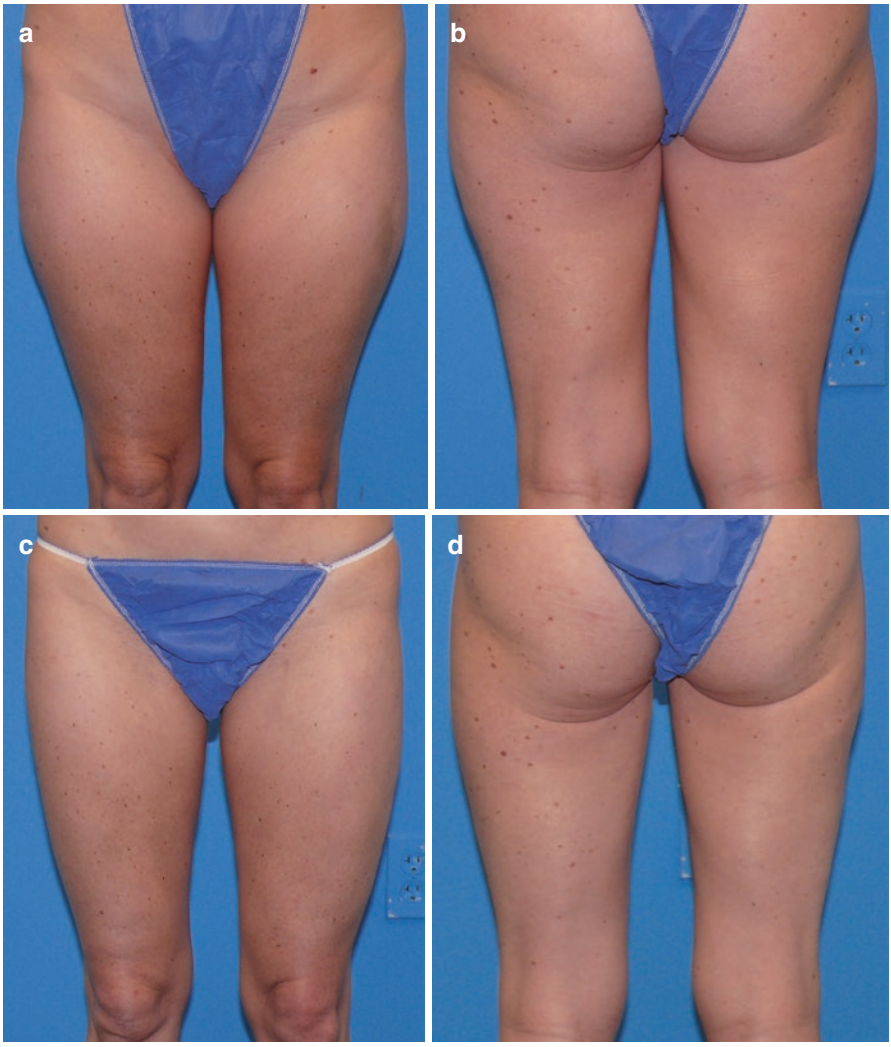

Fig. 8.9 (**a–d**) A 38-year-old woman 6 months post-circumferential VAL of her trunk and thighs

3.7 mm, five-ring probe at 70% energy level in pulsed mode was utilized for 3 minutes per arm. The aspiration was performed with 3.0 mm VentX cannula. The total aspirate removed during the surgery was 560 ml. Approximately 210 ml of supernatant fat was removed from each arm. Surgical results at 6 months are displayed in Fig. 8.10a–d.

A 30-year-old multiparous woman was seen in consultation regarding improvement in the contour of her arms. She has undergone a 70 pound weight loss and has

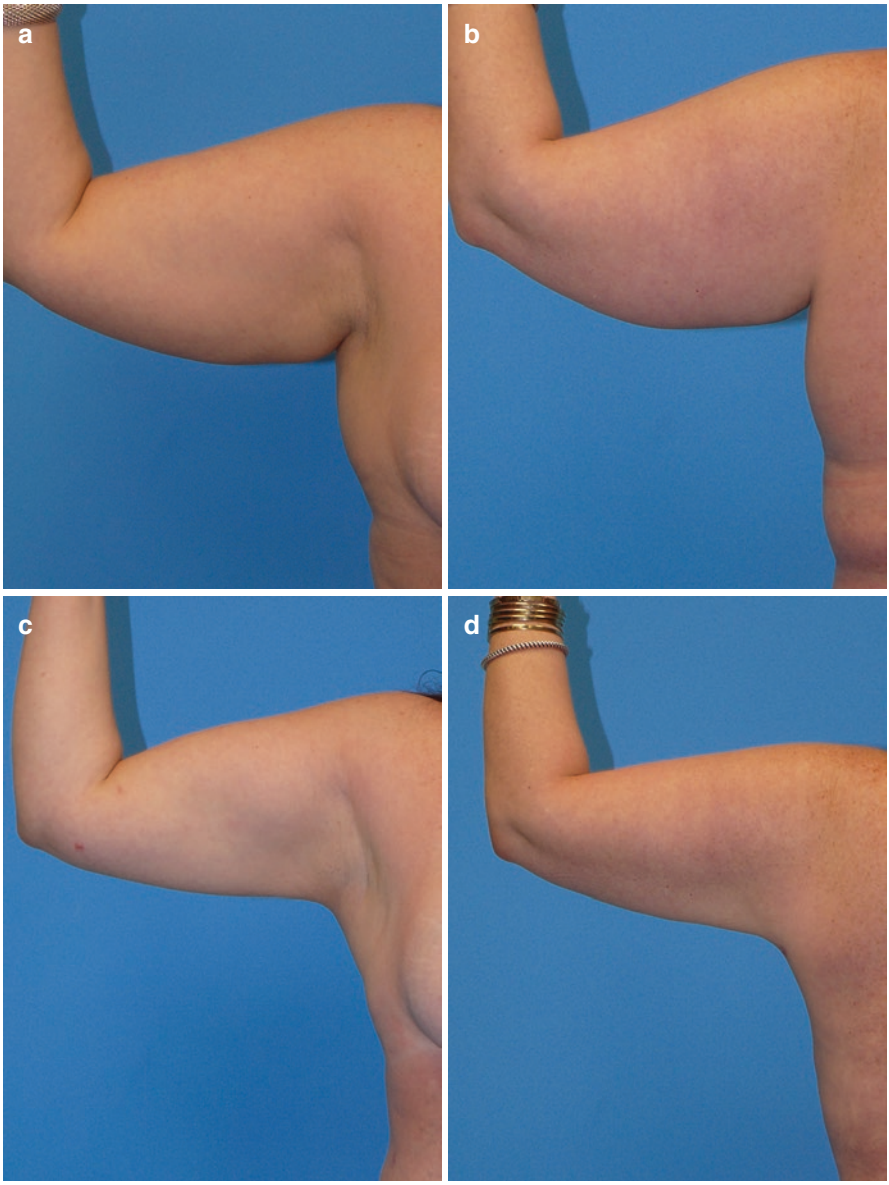

Fig. 8.10 (**a–d**) A 38-year-old woman 6 months post-circumferential VAL contouring of her arms

moderate skin tone in her arms. She underwent outpatient circumferential VAL of her arms under general anesthesia. A total of 400 ml of the author's wetting solution was infused into each arm at 250 ml/minute. A 3.7 mm, three-ring probe at 70% energy level in pulsed mode was utilized for 3 minutes per arm. The VASER was applied for a slightly longer time interval than usual (2 minutes instead of 1 minute/100 ml of expected aspirate) in order to aid with skin retraction. The total VAL aspirate for the surgery was 320 ml. Approximately 120 ml of supernatant fat was removed from each arm. The postoperative results at 1 year are depicted in Fig. 8.11a–d.

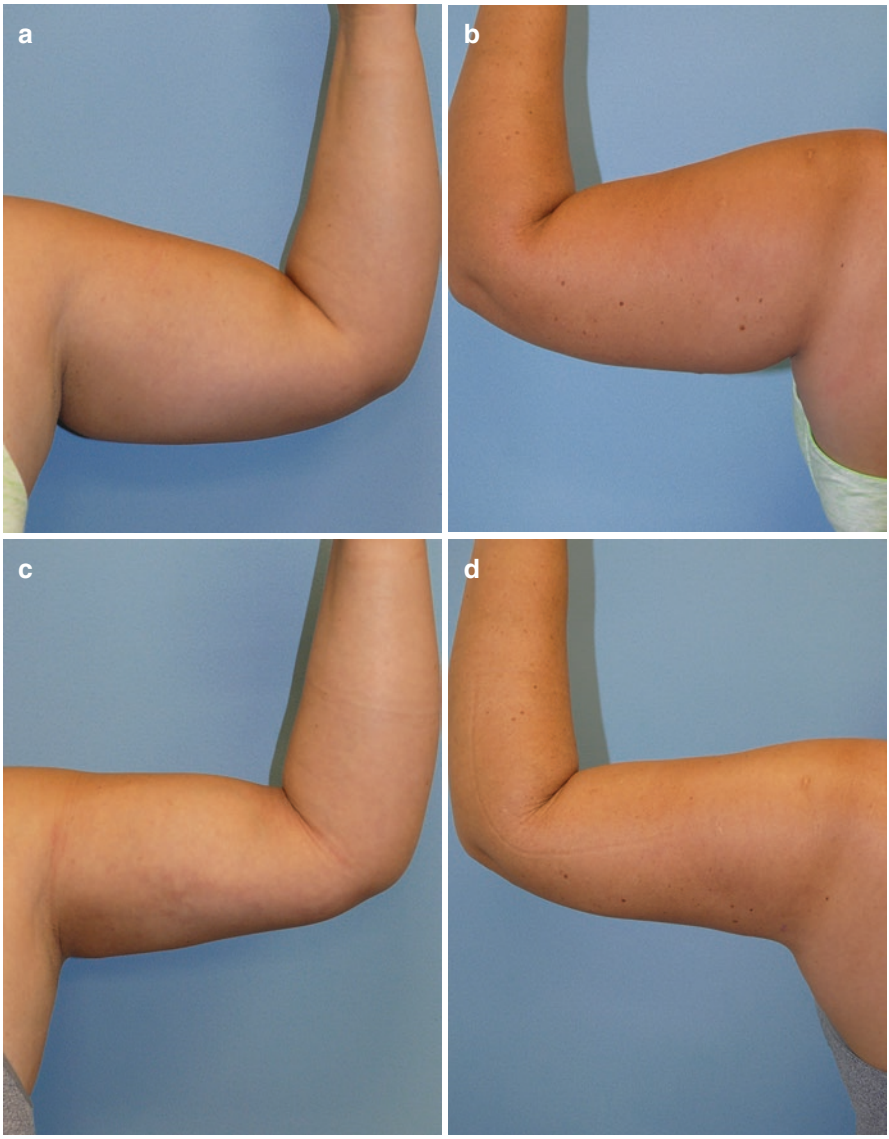

Fig. 8.11 (**a–d**) A 30 year-old-woman, 1 year post-circumferential VAL contouring of her arms

Postoperative Considerations

Liposuctions of greater than 8 L of total aspirate should be performed as inpatient procedures in order to properly monitor the fluid replacement and urine output. It has been generally accepted that about 30% of the infused wetting solution is removed with the aspirate and that the other 70% is eventually absorbed into the intravascular space over the first 12 hours postoperatively [16]. Currently higher amounts of wetting solution are recommended for VAL and although the amount removed in the aspirate remains about one third of the infused solution, the other 65–70% of the wetting solution is not necessarily absorbed into the bloodstream [17]. The high wetting solution volumes used in VAL are associated with significant unquantifiable losses through the access incisions resulting from the high internal pressure created by the infused fluid. This takes place during the surgery, immediately following the aspiration phase when the surgeon performs rolling massage of the treated areas removing a significant volume of the solution and also during the first 24 postoperative hours when frequently there is significant leakage through the access incisions. In the author's experience, less than 50% of the wetting solution is absorbed into the intravascular space. These factors and significant patient variability create difficulties using a "one size fits all" formula for fluid replacement in high-volume liposuctions. For those reasons, all high-volume VAL patients are kept hospitalized overnight with an indwelling Foley catheter and the fluid replacement is administered in accordance with maintaining a urine output of approximately 1 ml/kg/hour. These patients are allowed liberal oral fluid intake as soon as they are awake and early ambulation is encouraged. These patients are discharged on the first postoperative day. Small- and moderate-volume VAL cases are performed as outpatient procedures. Ambulation and liberal intake of oral fluids is encouraged.

TopiFoam dressings and compression garments are applied to most patients following the surgery (Fig. 8.12a–c). High circumferential VAL cases are the exception because of the high-volume drainage through the incisions in the early postoperative period. In these patients the foam and compression garments are placed after the first 24 hours. VAL patients have skin dryness for the first few weeks and a skin moisturizing regimen is recommended during that period along with lymphatic massages.

VASER-Assisted Brachioplasty

Brachioplasty was first described in 1954 by Correa-Inturraspe and Fernandez [18]. The procedure remained relatively uncommon for years until the advent of bariatric surgery and the influx of massive weight loss patients into the plastic surgeon's offices.

Patients with arm lipodystrophy and poor skin tone benefit from a combination arm contouring procedure. Combining arm liposuction with a brachioplasty skin resection

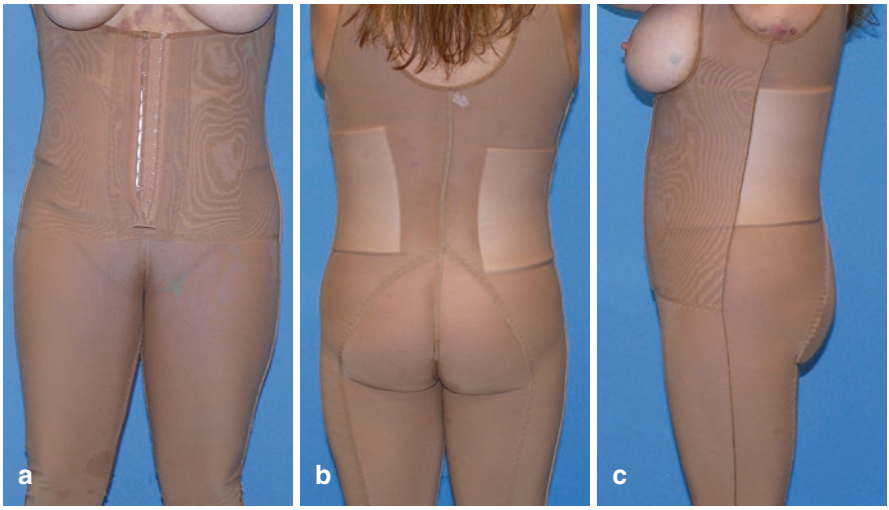

Fig. 8.12 (**a–c**) Typical post-VAL compression garments over TopiFoam adhesive silicone backed pads

has been described by Hurwitz [19, 20]. In VASER-assisted brachioplasty, the excess arm fat is addressed with VAL and the resulting excess skin is resected without undermining. This approach preserves much of the lymphatics and avoids empty space.

A survey regarding brachioplasty scar placement by Strauch and Greenspun [21] involved plastic surgeons, patients, and the public at large. The results revealed a predilection for the bicipital groove as the most acceptable scar location. Also at polls taken during plastic surgery meetings, the most common scar placement is the bicipital groove [22]. On the other hand, Capella [23] notes, in a large series of brachioplasty patients, a more favorable patient feedback from scars placed in a posterior-medial location on the arm. After many years of experimenting with different locations for brachioplasty scar placement, the author has settled on placement of the resulting scar on the posterior aspect of the arm. Although the argument against this approach is that it places the scar in an area visible to others from behind, many patients prefer that the scar not be visible to them and do not really care if others can see it [24]. Also, and more compelling, is the fact that in my experience the scar quality is superior in the posterior aspect of the arm when compared to scars placed in the bicipital groove.

Regardless of technique, all brachioplasty consultations should include lengthy discussions about the resulting scar. Patients need to understand the trade-off between an improved arm contour and a visible scar that usually extends from the axilla to the elbow. Making this discussion even more difficult is the fact that the resulting scar quality is almost impossible to predict preoperatively. Reviewing postoperative photos of brachioplasties during the consultation process is a useful method for educating patients on the location of the scar and the variations in scar quality among patients.

Markings for a brachioplasty are performed with the patient in the standing position. The arm is extended 90° from their trunk and the elbow flexed 90°. The areas designated for VAL are mapped and the desired incision line is marked in the posterior midline or in the posterior medial aspect of the arm. The markings corresponding to the excess skin resection are performed once the lipodystrophy has been addressed with the VAL. A pinch test is used to evaluate the amount of redundant skin which is then marked as an ellipse in the posterior arm. The majority of the fatty deposits in the arm occur in the posterior area and this has been confirmed by Chamosa et al., in cadaver studies [25].

Since the author performs most of these cases under general anesthesia, the wetting solution consists of 1 mg of epinephrine 1:1000 in 1 L of lactated Ringer's solution at room temperature. Lidocaine is not used in general anesthesia case. The wetting solution is infused by means of an infusion pump at a rate of 250 ml/minute until the solution is well distributed. A 3.7 mm, five-ring VASER probe is used at 60–70% energy level, in pulsed mode for 45 seconds per 100 ml of expected aspirate volume. Aspiration is performed using 3.7 mm and 3.0 mm VentX blunt cannulas. Following the VAL, a pinch test is used to determine the amount of redundant skin which is mapped out as an ellipse in the posterior arm using a surgical marking pen. The markings should allow a tension-free pinch at the widest portion of the ellipse since the resection and closure should be performed without undermining adjacent tissues. Several perpendicular lines across the ellipse aid in tissue alignment for the closure which is performed in two layers. The author typically uses several deep interrupted sutures of 2–0 absorbable monofilament to obliterate empty space followed by an absorbable, monofilament subcuticular closure. It is of paramount importance that this closure is tension-free to avoid wound healing complications and widened postoperative scars. Drains are not typically employed since there is little if any empty space created by this technique.

There is currently some controversy about the use of compression garments. For years postoperative compression has been recommended as a means of controlling the swelling and empty space associated with these procedures. These garments are frequently uncomfortable for the patient in the immediate postoperative period and are not without complications since they can pinch the skin, create skin creases, and occasionally create excessive swelling distal to the compression. For these reasons, many surgeons are now avoiding the use of compression garments particularly in the immediate postoperative period. Also, current brachioplasty techniques that avoid tissue undermining preserve the lymphatics and have tension-free closures which are associated with minimal postoperative swelling and virtually no empty space. Currently the author is not using compression garments immediately after surgery. Days later when the swelling and surgical discomfort have subsided, the compression garments are used in combination with silicone gel sheeting to improve the quality of the resulting scar [26].

Surgical Outcomes

A 60-year-old woman was seen status post 80 pound weight loss in consultation regarding arm contouring. Her arms reveal significant loss of skin tone and moderate lipodystrophy. A VASER-assisted brachioplasty was discussed and agreed upon as the recommended technique for improving the contour of her arms.

The surgery was performed as an outpatient procedure under general anesthesia, in the supine position, and with the arms circumferentially prepped and draped on a hand table so that it could be freely manipulated for the VAL portion of the surgery. Wetting solution consisted of 1 mg of epinephrine 1:1000 in a liter of Ringer's lactate solution. Preoperative markings were performed in the standing position mapping out the area for the VAL. Access incisions were conveniently placed in the proximal and distal midline of the posterior arm since this area would be part of the brachioplasty skin resection. An infusion pump was used to infiltrate a total of 300 ml per arm at a rate of 250 ml/minute evenly dispersed throughout the surgical sites. A 3.7 mm, five-ring probe at 60% energy level in pulsed mode was employed delivering only 2 minutes of ultrasound energy per arm since there was minimal tissue resistance to the ultrasound probe. A total of 300 ml (210 ml supernatant fat) was extracted from each arm using 3.7 mm and 3.0 mm VentX cannulas. Using the pinch test, an ellipse was marked in the posterior arm surface that would allow a tensionless closure without tissue undermining. A two-layer closure was performed, with deep interrupted absorbable sutures obliterating the empty space and a subcuticular dermal closure followed by cyanoacrylate wound sealant (Dermabond) on the skin. Drains were not used. A compression garment was applied after 2 weeks over silicone gel sheets placed in contact with the scar. The surgical results at 4 months are depicted in Fig. 8.13a–d.

A 53-year-old woman seen in consultation regarding improvement in the contour and size of her arms. She presents with significant lipodystrophy of her arms with poor skin tone. A VASER-assisted brachioplasty was recommended as a means of addressing both diminishing the volume and improving the skin tone of the arms. Preoperatively the patient was marked in the standing position mapping out the area of the VAL as well as the posterior midline. The skin resection ellipse margins are marked following the fat extraction. Access incisions are placed in the proximal and distal posterior midline of the upper arm since this allows direct lineal access for the VAL probes and suction cannulas and are removed with the skin resection of the brachioplasty. The author's wetting solution formula consisting of 1 mg of epinephrine 1/1000 in a liter of Ringer's lactate solution is infused at a rate of 250 ml per minute with even dispersion throughout the mapped areas. A total of 450 ml was infused into each arm. A 3.7 mm, five-ring VASER probe was employed at 70% energy level in pulsed mode for 3 minutes per arm. Aspiration was achieved with 3.7 mm and 3.0 mm VentX cannulas, removing a total of 575 ml (approximately 420 ml supernatant fat), from each arm. Following the VAL, a rolling massage of the area was performed removing residual wetting solution through the access incisions. A pinch test was used to estimate the excess skin and an ellipse was marked

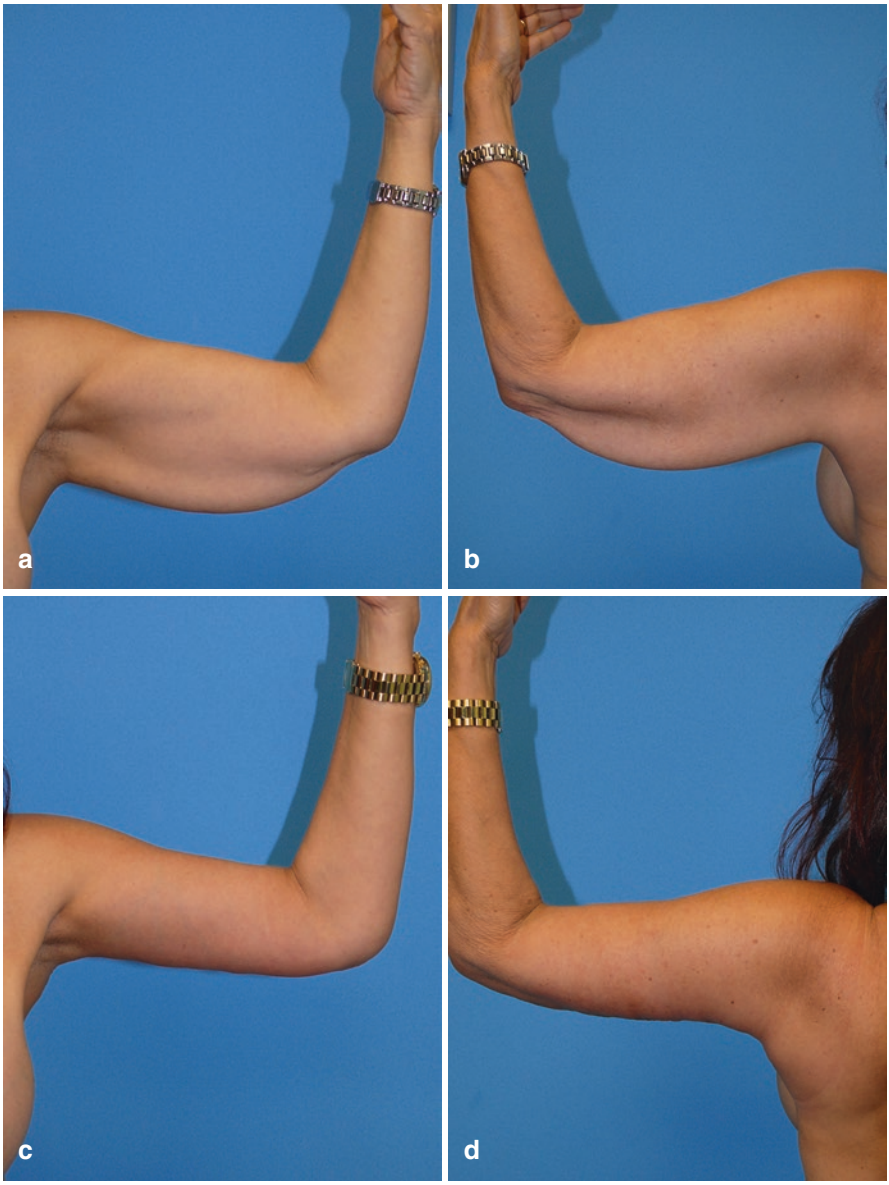

Fig. 8.13 (**a**–**d**) A 60-year-old woman post-bariatric surgery and 80 pound weight loss is 4 months post-VASER-assisted brachioplasty

in the posterior surface of the arm extending from the proximal elbow to the axilla that would allow a tension-free closure without tissue undermining. The closure was performed in two layers and consisted of deep interrupted, absorbable sutures followed by a subcuticular dermal closure. Since this technique does not create empty space, drains are not utilized. The skin was treated with cyanoacrylate (Dermabond)

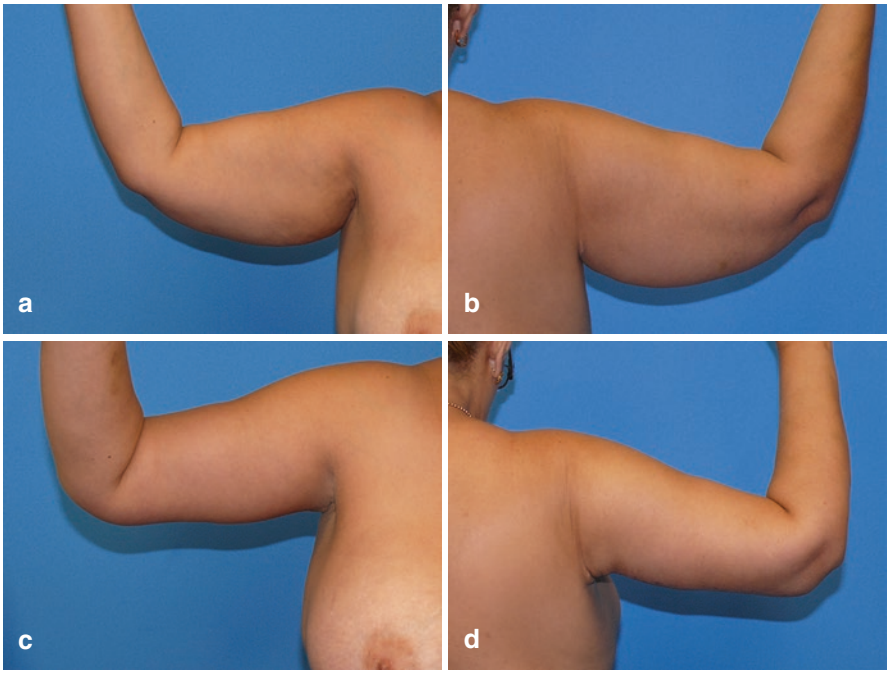

Fig. 8.14 (**a–d**) A 53-year-old moderately obese woman 6 months post-VASER-assisted brachioplasty

wound sealant. Use of the Dermabond sealant does not require any other wound dressings and provides a sealed barrier which allows the patient to shower at 24 hours. After 2 weeks, a compression garment was employed in conjunction with silicone gel sheets to enhance the quality of the resulting scar. The surgical results at 6 months are depicted in Fig. 8.14a–d.

Complications

The most common complication with any technique of brachioplasty is wound dehiscence. This is usually seen when the wound is closed under tension or when there is significant tissue undermining with devascularization of the wound edges. In cases where the incision is carried into the axilla, the moist nature of the area can also contribute to wound breakdown. The author prefers to treat the area in question with local wound care and allowing the wound to heal by secondary intention. A scar revision can be performed at a later date when all the edema has subsided and a tension-free closure can be accomplished.

Although hematomas can occur, they are relatively rare in the author's experience and can certainly be avoided by meticulous hemostasis and avoiding empty

space. In the event they occur, they should be promptly drained to avoid adhesions, skin discoloration, and in severe cases tissue necrosis.

Seromas are also not common. They are typically small and occur near the elbow or axilla. They respond well to serial aspirations and pressure.

Prolonged edema may occur following abnormally tight brachioplasty closures or extensive tissue undermining with disruption of the lymphatics. Physical therapy and lymphatic massages are helpful. Prolonged postoperative edema is extremely distressing to the patient so the best treatment is really prevention by avoiding tension on the closure and avoiding tissue undermining and empty space.

Widened and hypertrophic brachioplasty scars frequently occur following high tension closure. Occasionally they can be seen in tension-free closures; however in the author's experience they are more common when located in the bicipital groove than in the posterior area of the arm. Silicone gel sheets and compression beginning approximately 2 weeks after surgery and continuing for several months have shown promise in diminishing the scar sequelae. Occasionally scar revisions are helpful since the second time around, the tissues are more pliable if given enough time and the closure is not subjected to the postoperative inflammation related to the brachioplasty. Nguyen et al. [27] reported on the complications of brachioplasty in a series of over 2000 patients. They found the incidence of complications to be much lower than previously reported with hematoma at 1.1% and infection at 1.7% being the most common. In that series, combined procedures, males and BMI >30 were identified as independent risk factors.

VASER-Assisted Thighplasty

Although liposuction of the thighs is a common operation among plastic surgeons, thigh lifts or thighplasties are relatively uncommon surgeries. Last year the American Society for Aesthetic Plastic Surgery (ASAPS) reported less than 8000 thigh lifts out of over 1.5 million plastic surgeries reported [28]. The first description of combining a horizontal and vertical resection component in a medial thigh lift is attributed to Lewis [29], in 1957. Since then numerous authors have advocated a horizontal thighplasty incision with or without the vertical component [30–34].

It was Lockwood [35] who popularized medial thigh lifts and championed the use of fascial fixation [36] as an important component of the operation. His technique involved placing the incision in the groin crease but avoiding extension into the gluteal crease. He performed liposuction, some degree of undermining, and a conservative skin resection; however the main component of the technique involved obtaining a vertical lift of the thigh soft tissues by the approximation of the superficial thigh fascia to Colles' fascia in the groin. Lockwood was convinced that his technique of fascial fixation would allow for significant medial thigh lift in the vertical direction while avoiding complications related to skin closure tension such as labial spreading, scar migration, and poor scar quality. Most of Lockwood's patients however presented with thigh deformities as a result of aging and not with the sig-

nificant deformities and tissue attenuation seen in today's massive weight loss population. The feeling among many experienced body contouring surgeons is that thigh deformities in the massive weight loss patient are frequently associated with far more tissue laxity than what can be addressed with the limited skin resection associated with Lockwood's technique. Post-bariatric surgery patients can present with such a significant amount of medial thigh laxity that many surgeons [37–39] recommend a vertical incision with horizontal tissue resection and tightening in order to properly address these deformities. Many massive weight loss patients however do not present with extreme skin laxity and many still have varying degrees of residual thigh lipodystrophy. It is in these cases that the author prefers a combination procedure combining VAL for the volume reduction with a vertical thighplasty through an extended groin crease incision.

Preoperative Considerations

The author reserves the VASER-assisted thighplasty procedure for patients with varying degrees of thigh lipodystrophy but mild to moderate medial thigh skin laxity. Preoperatively a complete history and physical is performed taking note of any previous history of body contouring procedures, comorbidities present, amount of weight loss and over what time interval, type of bariatric surgery if any, previous pregnancies, plans for future pregnancies, and for how long has the present weight been stable. It is important to note a history of smoking, peripheral vascular disease, venous insufficiency, or lymphedema. A complete preoperative medical clearance is required of these patients. The physical exam should take into account any excess in the mons pubis that may need to be addressed. Preoperatively the surgeon should carefully estimate the amount of medial thigh lipodystrophy and the extent of medial thigh laxity. With the patient standing and the thigh abducted, the soft tissues of the medial thigh are grasped and pulled superiorly demonstrating the degree of tissue upward mobility. Markings are performed in the standing position. The areas for VAL are marked along with the incision line within the groin crease extending to the medial gluteal crease. An estimate of the skin resection is marked as a hemi-ellipse on the upper medial thigh but this is modified after the VAL fat extraction using a pinch test.

Surgical Technique

The surgery is performed under general anesthesia. Prophylactic antibiotics are administered and sequential pneumatic compression booties are used. Although some surgeons prefer the prone-to-supine positions, the author prefers supine-to-supine in lithotomy stirrups. Access incisions for the VAL are placed in the superior medial thigh within the area marked for thighplasty skin resection. The wetting

solution consisting of 1 mg of epinephrine 1/1000 in a liter of Ringer's lactate solution is infused at a rate of 300 ml per minute, evenly dispersing it throughout the areas marked for VAL. A 3:1 ratio of wetting solution to estimated aspirate volume is employed. A 3.7 mm, five-ring VASER prove is utilized at 60% energy level in pulsed mode for approximately 45 seconds per 100 ml of expected aspirate volume. Previous VASER exposure time recommendations called for 1 minute of VASER exposure for every 100 ml of wetting solution employed. This formula exposes the tissues to far more ultrasound energy than is necessary to achieve adequate fat fragmentation and should be avoided. The aspiration is performed using 3.7 mm and 3.0 mm VentX cannulas. A rolling massage of the medial thigh tissues is performed following the aspiration in order to remove residual fluids through the access incisions. Using the pinch test, the excess tissue in the superior medial thigh is marked as a hemi-ellipse with the base being the incision line marked on the crease. Several lines are also drawn perpendicular to the hemi-ellipse to aid in wound alignment during the closure. Only the skin and soft tissue that can reach the groin crease with minimal or no undermining is resected. The resection is carried into the medial gluteal crease posteriorly and anteriorly into the mid groin crease or it can be connected with a previous abdominoplasty scar if needed to remove excess tissue. Appropriate soft tissue fixation is of paramount importance for this surgery to succeed. Even though Lockwood's fascial fixation technique significantly improved thighplasty results, some surgeons feel that fascial fixation alone may be insufficient for a number of massive weight loss patients with significant tissue laxity. The author's current technique calls for fixation of the Scarpa's fascia of the thigh to the pubic periosteum anteriorly and the ischial periosteum posteriorly as described by Shermak et al. [40]. Although I am in agreement with the use of large gauge, permanent, interrupted sutures for the periosteum fixation, my preference however is not to use braided sutures in these cases. I use strictly monofilament sutures and a #1 Prolene serves the purpose well. Following this fixation there should be obliteration of all empty space and a tensionless skin closure which is performed in two layers using 2–0 Monocryl for the deep layers and a 3–0 Monocryl subcuticular closure for the dermis. Cyanoacrylate tissue adhesive (Dermabond) is used to seal the wound. Due to the absence of empty space with this technique, drains are typically not utilized.

Postoperative Considerations

Frequent ambulation is encouraged immediately postoperatively as tolerated so long as patients avoid thigh abduction to prevent excessive tension on the suture lines. After 24 hours the patients may shower without scrubbing the surgical sites since the Dermabond serves as a waterproof wound shield. Compression garments over silicone gel sheets on the scars are recommended after the second postoperative week. Walking and upper body exercises are recommended the first 2 months after which the patient may resume all types of exercise.

Surgical Outcomes

A 37-year-old woman has lost 60 pounds following a gastric sleeve procedure. She is approximately 1 year status post-abdominoplasty and mastopexy procedures and has maintained a stable weight. She seeks to improve the contour and skin tone to her inner thighs. Exam reveals a moderate amount of lipodystrophy with moderate tissue laxity. She has well-healed mastopexy and abdominoplasty scars. A VASER-assisted thighplasty was recommended. The surgery was performed under general anesthesia as an outpatient procedure. The access incision for the VAL was placed in the proximal medial thigh within the margins of the skin resection. A liter per thigh of the author's recommended wetting solution was infused at a rate of 300 ml per minute into the areas marked for VAL. A 3.7 mm, five-ring VASER probe at 60% energy level in pulsed mode was employed for 3 minutes in each thigh. Aspiration was performed using 3 mm VentX cannulas. The total aspirate volume from each thigh was 520 ml and the supernatant fat volume was approximately 380 ml per thigh. A pinch test was applied to the medial thigh tissues after massaging the excess fluid through the access incisions in order to determine the tissue redundancy. The hemi-ellipse was marked accordingly in the upper medial thigh. Because of the relatively small soft tissue excess, the anterior incision stopped at the midpoint of the groin crease and the posterior aspect of the incision stopped at the medial gluteal fold. Four interrupted #1 Prolene sutures were used in the anterior Scarpa's fascia fixation to the pubic periosteum per thigh and three of the same sutures were used in the posterior fixation to the ischium periosteum per thigh. There was no undermining of the thigh tissues and drains were not used. The rest of the closure was accomplished with 2–0 Monocryl for the deep layers and a subcuticular closure of 3–0 Monocryl on the dermis. Dermabond was used to seal the skin. Compression garments over silicone gel sheeting were employed as scar therapy after 2 weeks. The surgical results at 14 months are depicted in Fig. 8.15a–d.

A 41-year-old woman has lost 110 pounds following bariatric surgery. She is approximately 1 year status post-circumferential body lift, has maintained a stable weight, and is now seeking correction of her inner thighs. Exam reveals relatively well-healed body lift scars. She has moderate lipodystrophy and severe tissue laxity but will not accept a vertical thigh scar. A VASER-assisted thighplasty was recommended with extended incisions through the groin creases to communicate with the abdominal scars anteriorly and into the gluteal crease posteriorly in order to address the significant medial thigh redundant tissue. Access incisions were placed in the proximal medial thigh within skin marked for resection. The wetting solution volume totaled 1.3 L per thigh infused at a rate of 300 ml per minute into the areas marked for VAL. A 3.7 mm, five-ring probe at 60% energy level in pulsed mode was employed for 4 minutes per thigh. Fat aspiration was performed with 3.7 mm and 3.0 mm VentX cannulas. A total of 650 ml was removed from each thigh and the supernatant fat yield was approximately 490 ml from each thigh. After massaging out the excess fluid a pinch test was used to estimate the amount of redundant tissue which was marked as a hemi-ellipse from the top of the groin crease communicating with the body lift scar anteriorly and extending into the gluteal crease posteriorly.

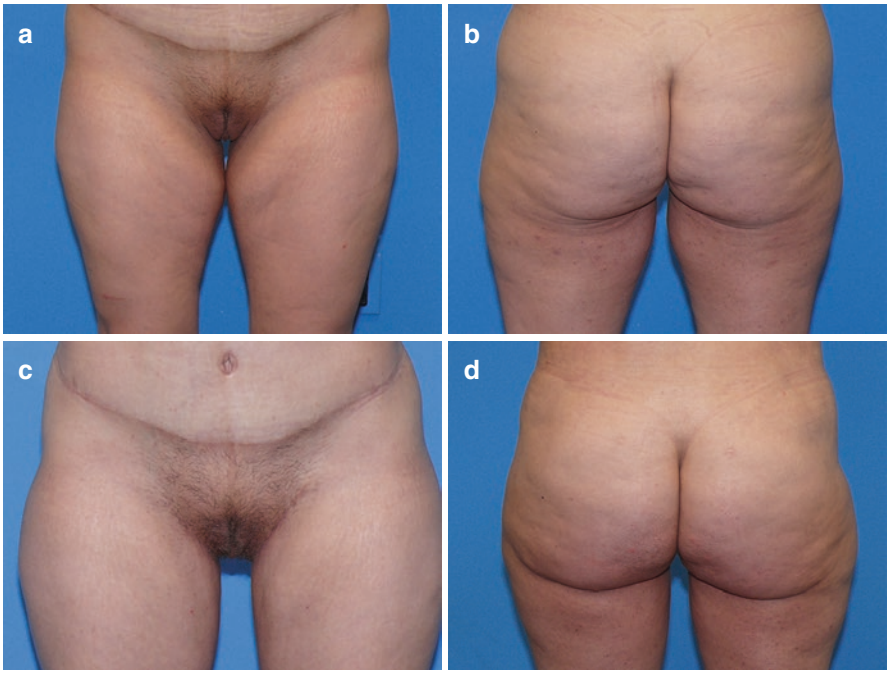

Fig. 8.15 (**a**–**d**) A 37-year-old woman post-bariatric surgery and 60 pound weight loss is 14 months post-VASER-assisted thighplasty

Five #1 Prolene sutures were used to fixate anterior medial Scarpa's fascia to pubic periosteum. Four fixating sutures of #1 Prolene were used to fixate posterior thigh Scarpa's fascia to ischial periosteum. There was no tissue undermining and no residual empty space created by the surgery so drains were not utilized. The tension-free wound closure consisted of 2–0 Monocryl sutures deep and 3–0 Monocryl subcuticular closure for the dermis followed by Dermabond on the skin. Compression garments over silicone gel sheeting were used after the second week as scar-reducing therapy. Surgical results at 1 year are depicted in Fig. 8.16a–d.

Complications

Complications following thighplasties are relatively frequent but they are typically minor when compared to complications from body contouring procedures in the trunk. Skin dehiscence is by far the most common complication of thighplasty. It is far more common in techniques that communicate a groin crease incision with a vertical component with the dehiscence occurring at the junction of the incisions. Capella and Woehrle [41] reported on a series of 250 thighplasties (N 500 thighs) and found a 28.4% incidence of wound dehiscence, 19.8% seromas, and 1.2%

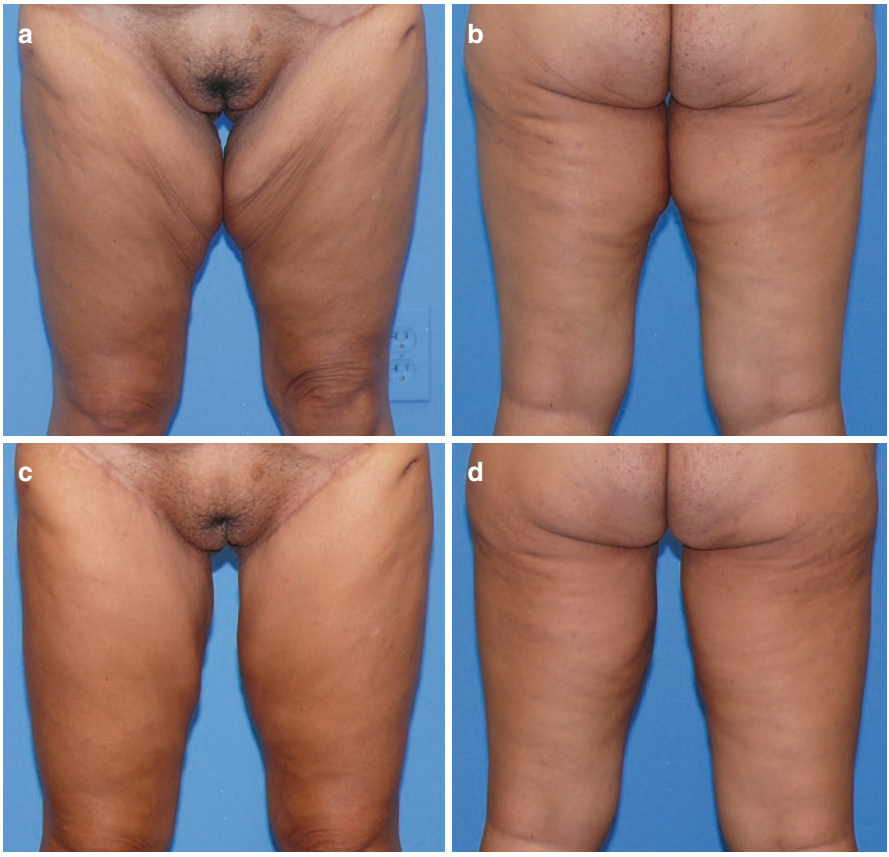

Fig. 8.16 (**a**–**d**) A 41-year-old woman post-bariatric surgery and 110 pound weight loss is 1 year post-VASER-assisted thighplasty

infection. Hematomas, skin necrosis, and deep vein thrombosis each occurred in less than 1% of cases. Pulmonary emboli did not occur in this series.

Skin dehiscence following thighplasty tend to be small and typically occur in the second postoperative week. The author prefers to treat these with local wound care allowing them to heal by secondary intention and then perform the resulting scar revision a year later. Wound dehiscence is a rare occurrence in VASER-assisted thighplasty since the scar is placed in the groin crease without a perpendicular vertical component.

Although seroma formation is the second most frequently reported complication of thighplasty surgery, it is relatively uncommon following VASER-assisted thighplasty that does not involve tissue undermining, preserves lymphatic drainage, and avoids empty space. They typically occur in the medial aspect of the thigh. Early diagnosis is the key since needle aspiration is most effective in small seromas of

short duration. The author prefers to closely follow these patients for the first 2 months seeing them every 2 weeks in order to address these problems should they occur.

VASER-assisted thighplasty is not associated with skin necrosis due to the tension-free closure and lack of tissue undermining. Infection and hematomas are rare occurrences. Deep vein thrombosis and pulmonary emboli are also rare; however sequential pneumatic compression devices are used during the surgery and the patients are encouraged to ambulate immediately after surgery.

Conclusions

VASER-assisted liposuction is a safe and effective technique for contouring both upper and lower extremities. The technique yields excellent aesthetic results and is associated with less blood loss and shorter postoperative downtime than traditional liposuction. An open procedure such as VASER-assisted thighplasty or VASER-assisted brachioplasty is recommended for patients who display poor skin tone in their extremities.

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Chapter 9
Aesthetic Contouring of the Buttocks

Onelio Garcia Jr.

Introduction

Liposuction remains the second most common surgical aesthetic procedure performed in the United States with over 300,000 cases reported to the American Society for Aesthetic Plastic Surgery (ASAPS) in 2017 [1]. Gluteal augmentation by means of fat grating is currently the 12th most common procedure with over 20,000 cases reported in 2017. That figure represents an increase of over 25% from the previous year, making gluteal augmentation the fastest growing surgical procedure currently performed by plastic surgeons.

The ideal shape for the female buttock has a rounded appearance that merges into the upper lateral thigh. Mendieta [2] described four general types of trunk/buttock shapes: A-frame, V-frame, square, and round with the A frame considered the most aesthetically pleasing. This, however, only addresses one-half of the visual perspective since the relationship between the buttock and the thighs is just as important. Vartanian et al. [3] recently reported on the ideal thigh, a study based on crowdsourcing assessment of the aesthetically ideal thigh and its relationship to the hips and buttocks. The study respondents chose the posterior view, thigh-buttock junction angle of 170° as the most aesthetically pleasing and an angle of 155° as the second most attractive. What all this means is that overall, respondents chose a wider thigh base in relation to the buttock width as the most attractive thigh shape. This study included a total of over 1000 responses almost evenly split between male and female, representing all adult age groups and multiple ethnicities. According to Ali [4], these findings represent a paradigm shift from the traditional assumed preference for slender thighs. Plastic surgeons should consider the aesthetic preferences of the public at large and most importantly avoid dissociation between the thighs, hips, and buttocks during body contouring procedures.

O. Garcia Jr. (✉)
Division of Plastic Surgery, University of Miami, Miller School of Medicine, Miami, FL, USA

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Although gluteal fat grafting is sometimes necessary to achieve the ideal buttock contour, it is the fat extraction from surrounding anatomical areas that offers the greatest contribution to the final aesthetic result. Contouring of the posterior trunk, upper lateral thighs, and infra-gluteal rolls has a profound effect on the shape of the buttocks [5]. When contouring the thighs as a complement to the buttocks, it is important to pay special attention to the zones of adherence (Fig. 9.1). The five zones described consist of {1} the lower lateral thigh area of the iliotibial tract, {2} the gluteal crease, {3} the lateral gluteal depression, {4} the mid-medial thigh area, and {5} the posterior distal thigh above the popliteal crease. Preserving the gluteal crease is of paramount importance and one should avoid disrupting the crease with either ultrasound probes or suction cannulas. The author has found that zone 4, the mid-medial thigh area, is a relative contraindication for contouring. In patients with significant lipodystrophy of the thighs, this area is frequently addressed with judicious fat extraction in order to properly blend the superior medial thigh with the medial knee region [6].

It is the author's preference to perform VASER-assisted liposuction (VAL) for body contouring procedures including harvesting for gluteal fat grafting. The VAL

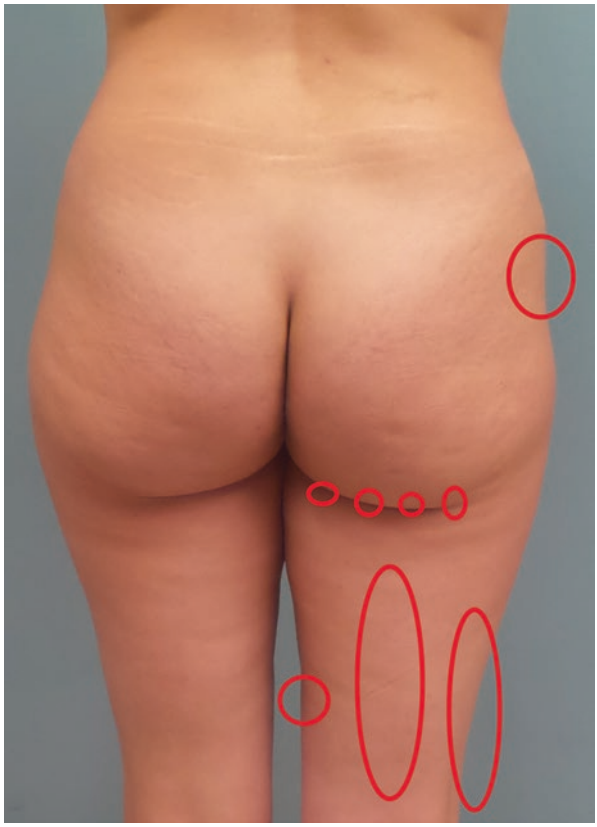

Fig. 9.1 Zones of adherence that should be avoided during contouring of the lower extremities

procedure is far less traumatic than traditional liposuction (SAL); yields highly aesthetic, precise, results; and has minimal associated complications [7, 8]. In addition, the author has reported significantly less blood loss in the aspirate of a large series of VAL patients following contouring of the posterior trunk when compared to SAL patients who underwent contouring of similar areas [9, 10]. When used at the clinically recommended settings, VASER aspirate is an emulsion of live adipocytes. The adipocyte viability in VASER aspirate has been confirmed by several studies [11, 12]. It is the author's opinion that scanning electron microscopy of the aspirate specimen is far more accurate than simple viability stains in assessing the quality of a fat harvest. Adipocytes exposed to higher levels of ultrasound energy can display altered morphology under electron microscopy evaluation but can still stain as viable under certain conditions [13]. In these instances the aspirate may contain viable adipocytes but morphological alterations present may render them unsuitable for fat grafting. Electron microscopy studies of VASER aspirate, acquired under clinically recommended energy settings and exposure times, display normal, unaltered morphology of well-separated adipocytes [14]. VASER aspirate acquired under these conditions serves as a highly suitable harvest source for fat grafting.

Preoperative Considerations

In regard to gluteal contouring, it is imperative that both the patient and the surgeon are well aligned in respect to the aesthetic goals of the operation. Is the patient seeking a rounder, more athletic buttock shape or just simply a bigger butt? Sculpting a round, athletic buttock shape typically does not require adding volume. Fat grafting may be required in some cases where the contouring alone is not enough to correct a visual gluteal deficiency, but in the author's experience with these cases, the grafted volumes are small to moderate and seldom exceed 500 ml per buttock injected into the subcutaneous plane. In recent years there has been a significant increase in the volumes grafted by some surgeons during these procedures. It was not unusual for surgeons to graft over 1000 ml of fat per buttock and occasionally the volumes grafted were as high as 1500 per buttock! These massive volumes required grafting into the gluteal muscles which significantly increased the surgical complications. Patient deaths as a result of fat emboli continued to rise [15], until gluteal fat grafting was associated with the highest mortality rate of any aesthetic surgical procedure.

For safety reasons, gluteal enhancement by means of fat grafting has recently become an operation of the subcutaneous tissues. As plastic surgeons move away from intramuscular grafting, the volumes grafted will need to be adjusted accordingly. Tissue compliance and overall gluteal surface area will play a significant role in determining the fat graft volume limits for a particular patient, in order to not exceed the recipient site capacity. Since subcutaneous grafting has obvious volume limitations, creating the visual of a voluminous buttock will require more aggressive contouring of the surrounding areas.

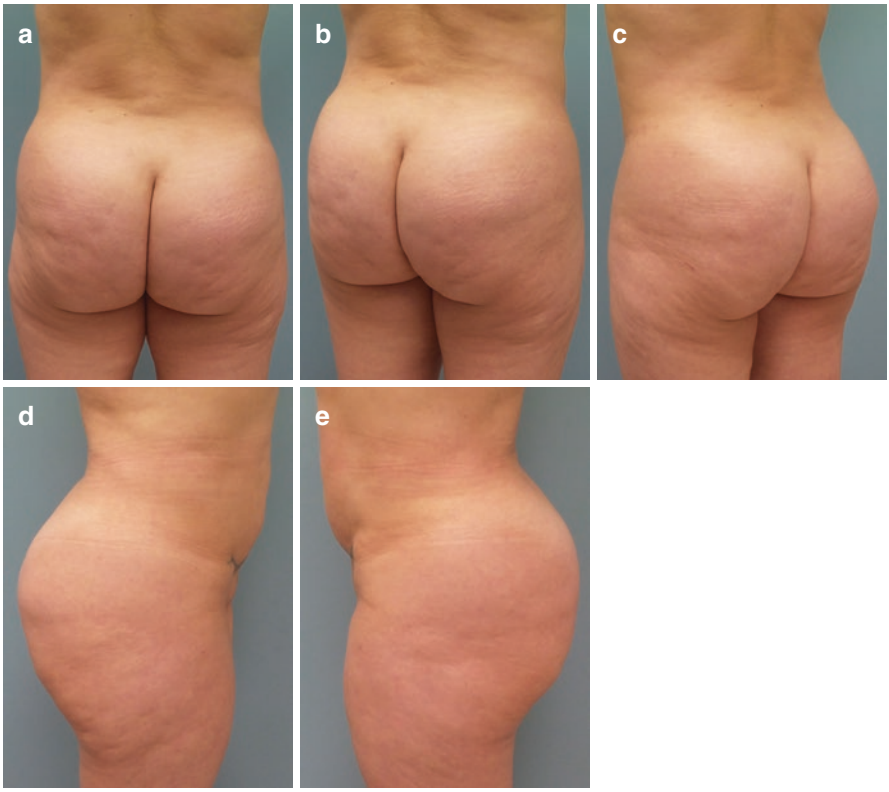

Fig. 9.2 Preoperative photography for gluteal contouring includes posterior, right/left oblique, and right/left lateral views. (**a**) posterior, (**b**) right oblique, (**c**) left oblique, (**d**) right lateral, (**e**) left lateral

Preoperative photography for gluteal contouring is performed with the patient standing with feet shoulder width apart. All garments are removed to expose the areas to be contoured and avoid distortion created by the elastic bands in the underwear. Five views are taken: posterior, right/left posterior oblique, and right/left lateral (Fig. 9.2a–e). The author typically adds a full posterior view from mid-thigh to the shoulders (Fig. 9.3), in order to evaluate the relationship between the buttocks, waist, and upper back. Preoperative markings for buttock contouring are performed in the standing position. The areas for fat extraction are marked, and in cases of gluteal fat grafting, the recipient areas are also meticulously marked (Fig. 9.4).

Surgical Technique

Gluteal contouring with or without fat grafting requires aggressive fat extraction from the posterior flanks. Lipodystrophy of the saddlebags and infra-gluteal areas also needs to be addressed by the extraction. As opposed to males where aggressive

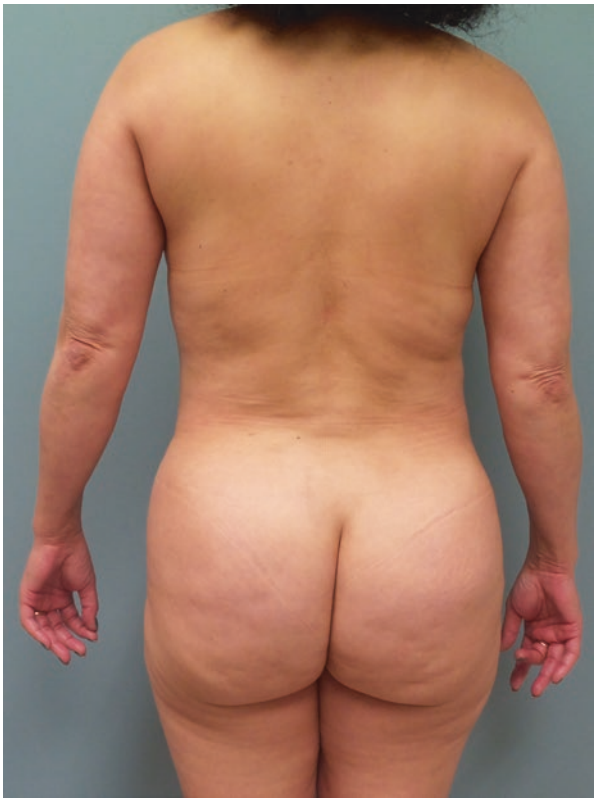

Fig. 9.3 A complete posterior view of the back is suggested in female patients to evaluate waistline contour

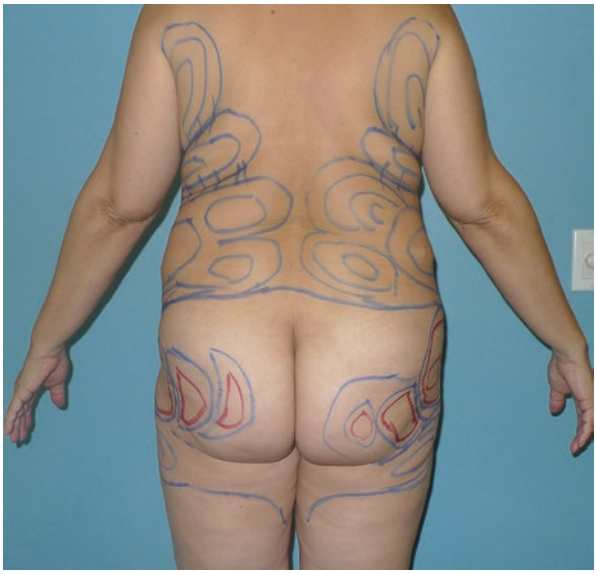

Fig. 9.4 Preoperative markings for gluteal contouring

contouring of the waist provides the desired aesthetic results (small waist/wide back), aggressive sculpting of the waistline on female patients requires extending the contouring into the upper back in order to avoid a masculine appearance postoperatively (small waist/wide back).

Positioning is somewhat controversial since some authors recommend the prone position for contouring the posterior flanks and back while others prefer the lateral decubitus position. The prone position is more convenient since it only requires that the patient be repositioned twice on the operating table (supine-prone-supine). Also, this position allows for visual assessment of both sides simultaneously. The lateral decubitus position requires that the patient be repositioned three times on the operating table (supine-right lateral decubitus-left lateral decubitus-supine). In spite of the slightly longer surgical times associated with the lateral decubitus positions, this author as well as other experienced body contouring surgeons frequently use the lateral decubitus positioning when contouring the waistline [16, 17]. The posterior triangle, an important component of the aesthetic waistline, cannot be adequately addressed from the prone position.

Since these cases generally involve contouring of fairly large surface areas, they are performed under general anesthesia and typically as an outpatient procedure. The lateral decubitus position requires padding of pressure points and an axillary roll. A Bean Bag Surgical Positioner (Medline Industries, Northfield, IL) is helpful in maintaining the desired patient position on the operating table. A Bair Hugger (3M, St. Paul, MN) is placed over the non-operative areas and the intravenous fluids are warmed. A Foley catheter is commonly used to monitor urine output in cases where high volumes of wetting solution are employed. The rationale behind the wetting solution formula has been discussed in detail elsewhere in this textbook (Chap. 4). For general anesthesia cases, the author employs a formula consisting of 1 ml of epinephrine 1:1000 in a liter of Ringer's Lactate solution at room temperature. Ultrasound to the posterior trunk is delivered by a 3.7 mm, 2-ring VASER probe (Solta Medical, Bothell, WA) at 80% in pulsed mode. Aspiration is performed with 4.6 mm, 3.7 mm, and 3.0 mm VentX cannulas (Solta Medical, Bothell, WA). Postoperatively, TopiFoam (Mentor Corp., Irvine, CA) and compression garments are utilized.

Surgical Outcomes

A 41-year-old overweight female was seen in consultation regarding defining her waistline as well as improving the contour of her abdomen, flanks, back, and hips. A recommendation was made for circumferential VASER-assisted liposuction of the trunk and hips. The surgery was performed as an outpatient procedure under general anesthesia. The contouring was performed in the right lateral decubitus to left lateral decubitus to supine positions. A Bean Bag surgical positioner was used to maintain stability in the lateral decubitus positions. A Bair Hugger was utilized over the non-surgical areas and the intravenous fluids were warmed. The author's wetting solution formula for general anesthesia, consisting of 1 ml of epinephrine 1/1000 per liter of room temperature Ringer's Lactate was infused by an infusion

pump at a rate of 400 ml/minute. A total of 7 liters of wetting solution were infused for the surgery with 4 liters employed in the posterior trunk. Ultrasound to the posterior trunk was delivered by a 3.7 mm, 2-ring VASER probe for 9 minutes per side at 80% level in continuous mode. Aspiration was performed with 4.6 mm, 3.7 mm, and 3.0 mm VentX cannulas. A total aspirate of 6150 ml was extracted circumferentially of which 4000 ml was supernatant fat. The areas of the posterior trunk and hips accounted for 2400 ml of the supernatant fat. Surgical results of the posterior trunk at 1 year are depicted in Fig. 9.5a–d. Note the improved gluteal contour as a

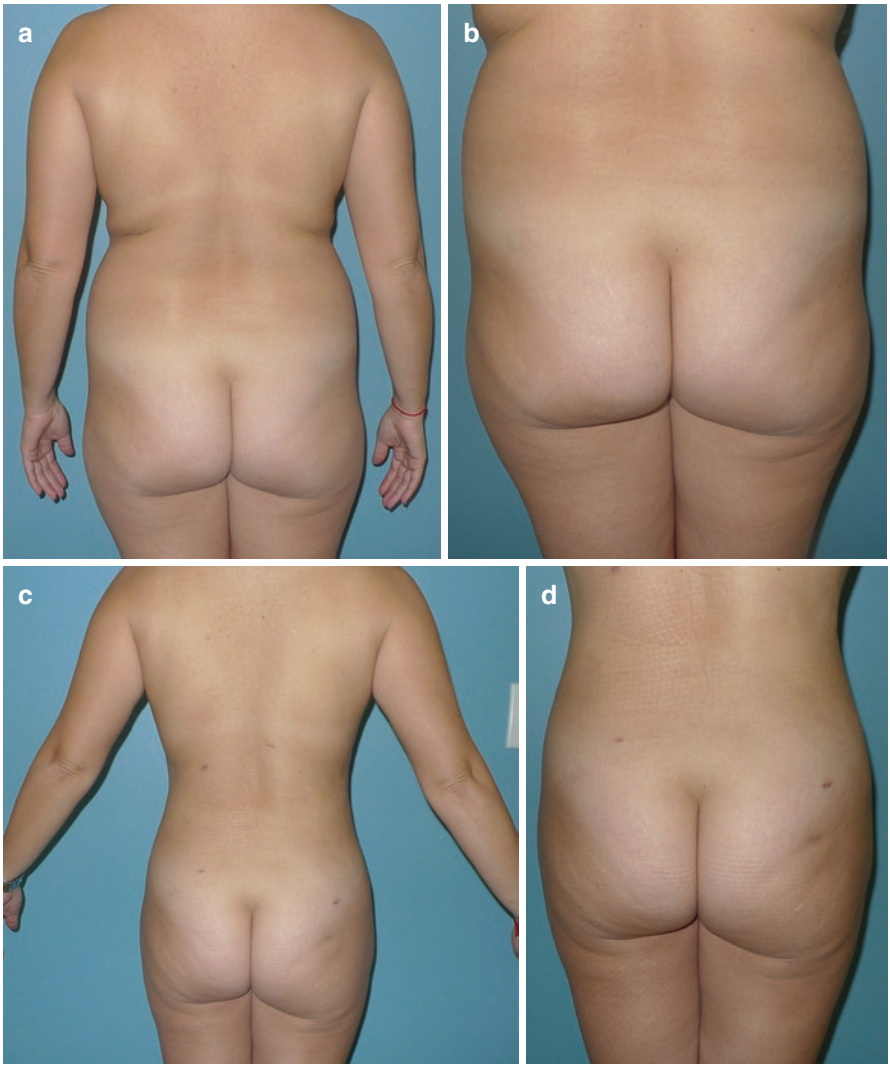

Fig. 9.5 (**a**, **b**) Preoperative appearance of 41-year-old female. (**c**, **d**) Postoperative results after VASER-assisted circumferential contouring of the trunk

direct result of aggressive contouring of the waistline and slightly decreasing the projection of the saddlebag areas.

A 22-year-old overweight female is interested in improving the contours of her trunk and the shape of her buttocks. A recommendation was made for circumferential VASER-assisted liposuction of the trunk. The surgery was performed as an outpatient procedure under general anesthesia. Positioning for the surgery consisted of lateral decubitus stabilized on a Bean Bag surgical positioner and supine. A Foley catheter was inserted as soon as the patient was anesthetized, and a Bair Hugger was used over the non-surgical areas. The author's wetting solution formula for general anesthesia cases was infused with a power infusion pump at a rate of 400 ml/minute. A total of 8 liters were employed for the procedure with 5 liters infused into the posterior trunk. The ultrasound was delivered with a 3.7 mm, 2-ring VASER probe at 80% for a total of 8 minutes per side in pulsed mode. Aspiration was performed using a 4.6 mm, 3.7 mm, and 3.0 mm VentX cannulas. The total aspirate was 5980 ml with 4000 ml as the supernatant fat fraction. The posterior trunk yielded 2500 ml of the supernatant fat. Surgical results at 8 months are depicted in Fig. 9.6a–f. Note the improved buttock contour in the posterior view. The aggressive de-bulking of the posterior flanks gives the appearance of improved buttock projection on the lateral views even though gluteal volume was not added as part of this procedure.

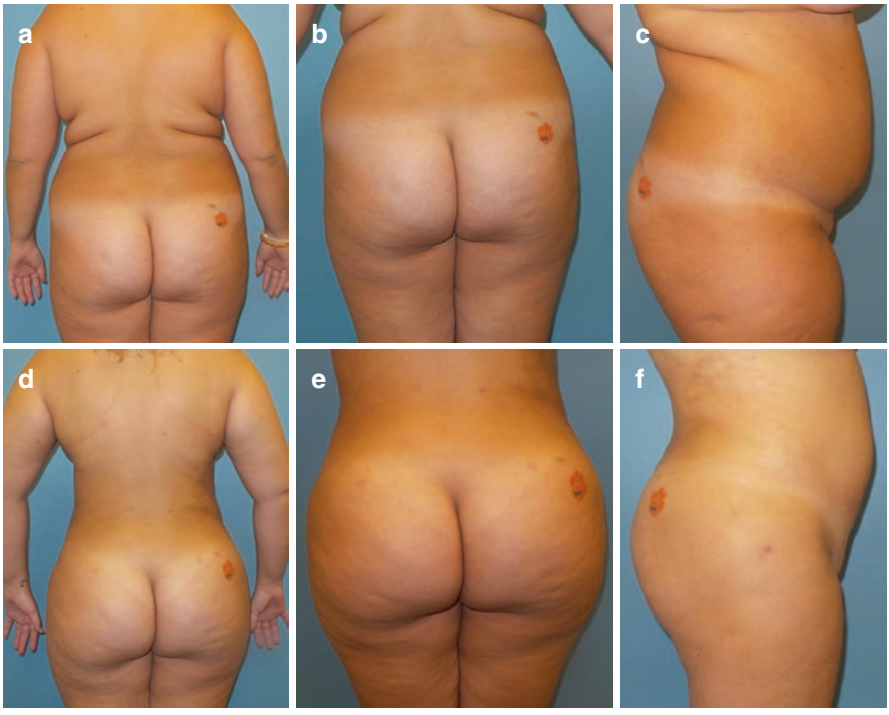

Fig. 9.6 (**a–c**) Preoperative appearance of a 22-year-old female. (**d–f**) Postoperative results after VASER-assisted circumferential contouring of the trunk

When contouring the buttocks, it is imperative that one not dissociate the gluteal area from the posterior trunk or the thighs. Aggressive circumferential contouring of the waistline has a profound effect on the shape of the buttocks. Decreasing the projection of prominent saddlebag deformities and judicious contouring of the infragluteal rolls also has a positive synergistic effect on the contour of the buttocks. Although, in some cases of gluteal contouring, the lateral views appear to have improved projection, it is only a visual illusion since volume is not added. Most of the contour improvements are seen in the posterior views, so this procedure appeals to patients seeking a rounder, more athletic buttock shape without adding volume. The following are examples of VASER-assisted gluteal contouring without fat grafting (Figs. 9.7a, b, 9.8a, b, and 9.9a, b). Patients who desire added projection can

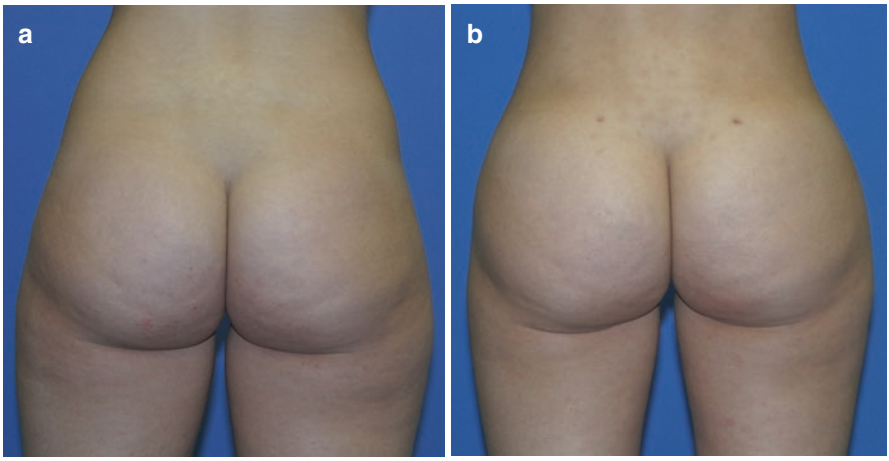

Fig. 9.7 (**a**) Preoperative. (**b**) Postoperative VASER-assisted gluteal contouring

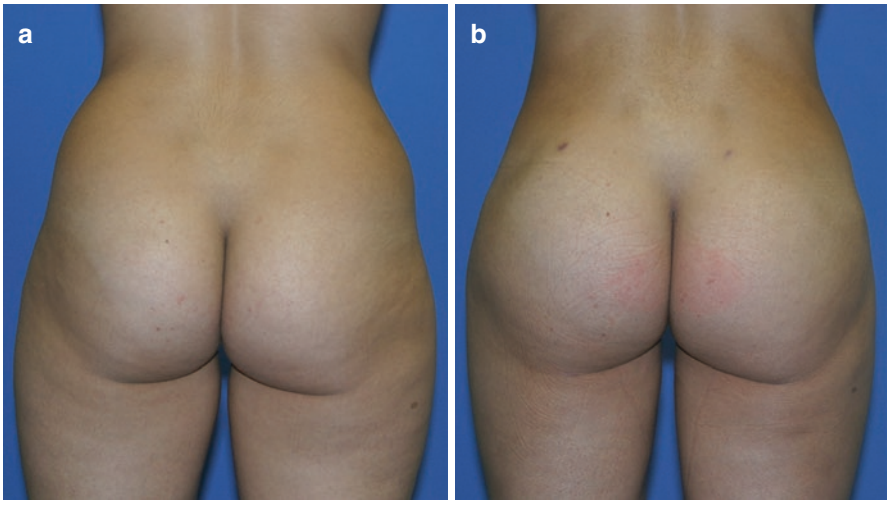

Fig. 9.8 (**a**) Preoperative. (**b**) Postoperative VASER-assisted gluteal contouring

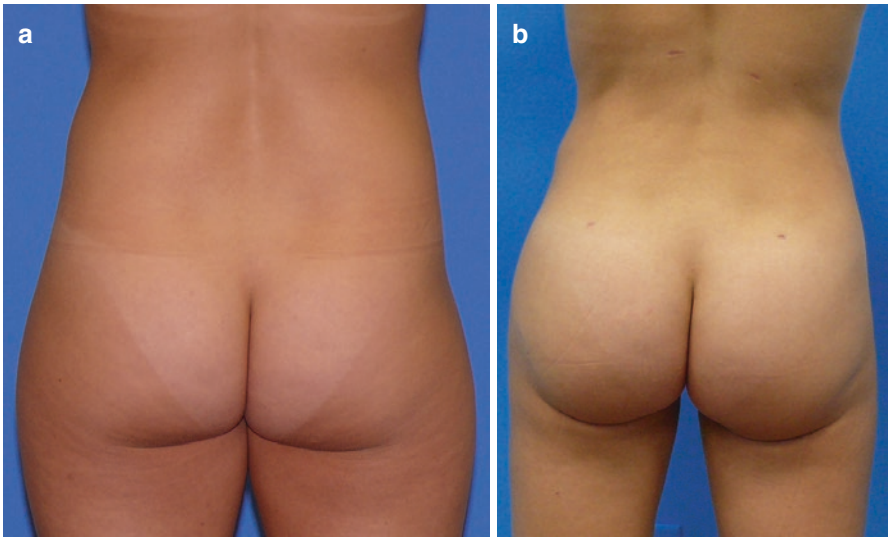

Fig. 9.9 (**a**) Preoperative. (**b**) Postoperative VASER-assisted gluteal contouring

undergo gluteal fat grafting; however, meticulous attention to the contouring will result in lower volumes grafted in order to achieve the desired visual results. The greater the diameter increase in a hemispheric dome, the greater the volume needed to maintain the same projection. In other words "don't increase the gluteal base diameter, decrease the waist diameter." Injecting fat only into the subcutaneous space is the centerpiece of the current recommendations for safety in gluteal fat grafting. There will be graft volume limitations based on what the recipient site can accommodate. The new mantra for this procedure should be "extract more and graft less."

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Part III
Special Applications

Chapter 10
ultraBBL: Brazilian Butt Lift Using Real-Time Intraoperative Ultrasound Guidance

Pat Pazmiño

Introduction

Gluteal contouring and augmentation have proven to be a powerful and extremely popular additions to the body contouring armamentarium of the plastic surgeon.

This has been driven largely by patient demand as over the last 10–20 years society's ideals of beauty have continued to expand. Beautiful is now possible at any size and in many shapes. Patients are specifically requesting fuller hips and buttocks both as stand-alone procedures and to complement other breast and body contouring surgeries [1–4].

It is possible to emphasize gluteal contours with liposuction and fat extraction alone. Mild asymmetries and depressions can also be effectively corrected with fat separation and fat shifting [5–7]. However, true gluteal augmentation can only be done with fat grafting.

Gluteal augmentation with fat grafting has been proven to be effective in the plastic surgery literature and memorialized by patients and surgeons throughout social media [2, 8]. This is a powerful technique, but it must be performed cautiously.

Over the last 10 years, there has been an excessively high number of complications and patient deaths after gluteal fat grafting. Fat pulmonary embolisms are the most common fatal complication that can occur when fat grafting is performed intramuscularly in the gluteus maximus and the fat graft is inadvertently injected into the gluteal veins [3, 9–11]. The now intravascular fat graft travels to the heart, lungs, and brain with fatal results. Deaths from fat pulmonary emboli have occurred

P. Pazmiño (✉)
Voluntary Faculty, Division of Plastic Surgery, University of Miami, Miami, FL, USA

Private Practice, MIAMI AESTHETIC, Miami, FL, USA
e-mail: dr@ultraBBL.com

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throughout the world, but in the United States, South Florida has been the epicenter of these tragedies. In the last 10 years, in South Florida alone, fifteen deaths from fat pulmonary emboli have been identified [12] (Lew, Emma, Letter to P. Pazmino, April 1, 2019). The author observed autopsies of these deaths when they were performed by the Medical Examiner of Miami Dade County. The postmortem results confirmed a two-hit hypothesis for this fatal complication: fat must be injected into the muscle around the deep gluteal veins and a gluteal vein injury must occur. These events most commonly occur when fat is injected into the gluteus maximus or deeper muscles and the fat grafting cannula inadvertently injures the gluteal veins, creating an opening for the fat graft to enter the venous system with fatal results [3] (Lew, Emma, Letter to P. Pazmino, April 1, 2019).

These autopsy results were reviewed by the Multi-Society Task Force for Safety in Gluteal Fat Grafting (Rubin, Mills, Saltz, et al.) as they designed cadaver research to further study this issue. The Task Force was able to delineate the vascular gluteal danger zone and describe safer cannula angles and lengths to avoid these injuries. The Task Force issued guidelines for safe gluteal fat injection which included constant vigilance of the cannula tip during fat grafting, a rigid cannula system, and most importantly to avoid intramuscular fat injection by staying above the deep gluteal fascia on the superior surface of the gluteus maximus at all times [13].

The operating surgeons of the South Florida fat pulmonary emboli mortalities used different fat graft volumes, different patient positions, different access incisions, and different cannula styles, but the one factor all of these deaths had in common was that every surgeon insisted that they were subcutaneous and above the deep gluteal fascia at all times. Unfortunately, the autopsies disagreed (Lew, Emma, Statistics on mortality after fat grafting and liposuction in Miami Dade County, personal communication, 2019). The South Florida experience demonstrates that surgeons currently do not have a consistent and reliable way to always know the position of their cannula tip during gluteal fat grafting. Furthermore, surgeons have no way to prove that they only injected fat subcutaneously and to document that they never injected fat into the gluteal muscles to protect themselves for medicolegal reasons.

It is because of the possible dangers with this procedure that plastic surgeons must not abandon gluteal fat grafting. Gluteal fat grafting is a powerful tool that can augment tissue, correct deformities, and create impressive results that cannot be produced any other way. Because of this, high patient demand for this procedure will continue. If board certified plastic surgeons stop performing this procedure, interested patients will simply go to the non-board certified practitioners who have had the majority of the complications [12] and even more deaths will occur. As researchers and patient advocates, plastic surgeons must study this technique and determine how gluteal fat grafting can be performed safely and consistently.

Ultrasound can help plastic surgeons achieve these goals. Ultrasound can be used to evaluate the thickness and quality of the subcutaneous envelope preoperatively. In the last 2 years, ultrasound equipment has become portable, wireless, and affordable opening the door for its use in the sterile field of the OR. Ultrasound visualization can be used with any cannula style or injection system [14]. Real-time intraoperative ultrasound visualization can help the surgeon perform fat harvesting

and accurate fat grafting into the unique spaces of the subcutaneous region. This will not only make for a safer surgeon, but a better surgeon – a surgeon who can manipulate subcutaneous anatomy not appreciable without ultrasound.

Gluteal Anatomy and Ultrasound

The pelvic bony framework, gluteal muscles, gluteal fat, and skin have been well described in our literature [2, 15, 16]. Ultrasound can help us accurately delineate and manipulate the subcutaneous zone. Cadaver dissections have actually identified two gluteal fascias (Fig. 10.1).

The superior surface of the gluteus maximus muscle is covered with a fascial plane (the deep gluteal fascia) that the Multi-Society Task Force has recommended surgeons do not penetrate [9, 13]. However, there also exists a second fascial layer (the superficial gluteal fascia) within the subcutaneous zone above the deep gluteal fascia and below the dermis. The superficial gluteal fascia is thick, is impregnated with fat, and can only be appreciated in an open dissection or with ultrasound visualization.

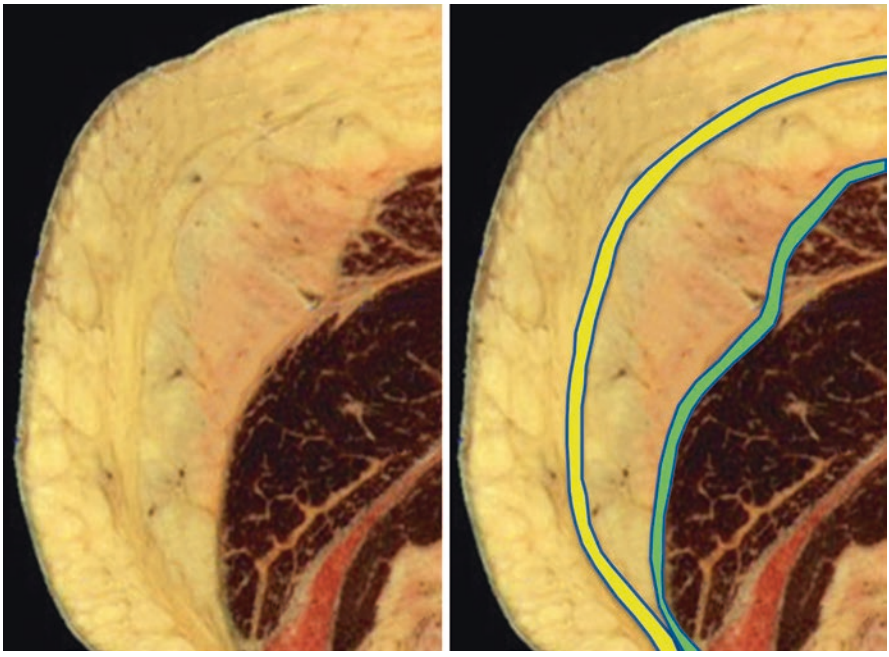

Fig. 10.1 Transverse cross section of female buttocks. The DEEP gluteal fascia (*green*) lies on top of the surface of the gluteus maximus muscle. The SUPERFICIAL gluteal fascia (*yellow*) is a distinct fascial layer analogous to Scarpa's fascia in the anterior abdomen and lies above the deep gluteal fascia and below the dermis, dividing the subcutaneous region into two spaces

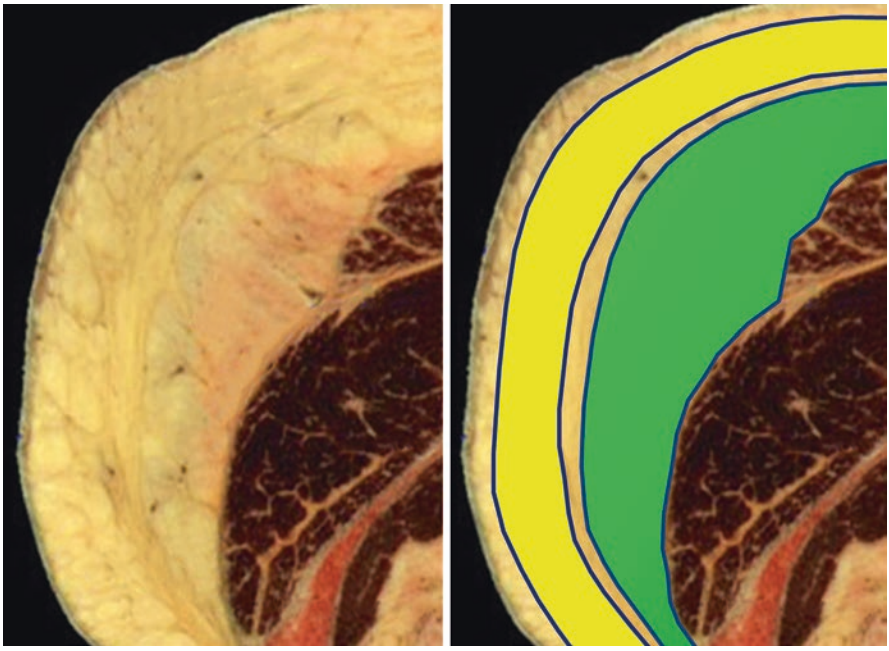

Fig. 10.2 Transverse cross section of female buttocks. The superficial gluteal fascia divides the subcutaneous region into two spaces. The SUPERFICIAL subcutaneous space (*yellow*) is below the skin and above the superficial gluteal fascia. The DEEP subcutaneous space (*green*) is below the superficial gluteal fascia and above the deep gluteal fascia. Ultrasound allows the surgeon to accurately enter each space and manipulate it while always remaining above the deep gluteal fascia

The superficial gluteal fascia is analogous to Scarpa's fascia in the abdomen and divides the subcutaneous zone into two subcutaneous spaces: the superficial subcutaneous space (between the dermis and the superficial gluteal fascia) and the deep subcutaneous space (between the superficial gluteal fascia and the deep gluteal fascia) [17] (Fig. 10.2).

More important clinically, if the superficial gluteal fascia remains intact, it can retain the fat graft that is specifically injected above or below it, like the casing of a sausage. Fat graft injected into the deep subcutaneous space (above the deep gluteal fascia and below the superficial gluteal fascia) can create excellent volume and central dome projection, similar to a subfascial implant. Fat graft precisely injected into the superficial subcutaneous space (above the superficial gluteal fascia and below the skin) can correct superficial contour deformities and depressions. The consistent accurate injection of fat graft into either the superficial or deep subcutaneous spaces can only be performed with real-time intraoperative ultrasound visualization.

It is also important to remember that the entire subcutaneous zone (including both the superficial and deep gluteal spaces) ranges in thickness from 1 cm (outer hips) to 3–4 cm (central gluteal dome). This thickness may also vary significantly between patients. This means that gluteal surgeons must graft in a thin space under a curving dome of varying thickness. This small variable target may account for the

inadvertent deep intramuscular injections by well-intentioned surgeons grafting without ultrasound visualization.

A surgeon can use real-time intraoperative ultrasound to not only avoid an intramuscular fat graft injection but to accurately target fat graft into the superficial or deep subcutaneous spaces. Neither of these techniques are possible without ultrasound. Real-time intraoperative ultrasound during a Brazilian butt lift (ultraBBL) can not only make fat grafting safer but much more powerful and accurate as well.

Preoperative Assessment

Like all plastic surgery, careful preoperative assessment and planning before gluteal contouring and fat grafting is essential. The surgeon should sit with the patient to understand their goals, priorities, and areas of importance. Asymmetries must be identified before surgery and a discussion should be held about the preoperative shape of the patient's waist, hips, buttocks, thighs, and back. The surgeon should ask what kind of shape the patient would like and understand how the patient would like to specifically change their waist, hips, point of maximum lateral hip projection, buttocks, thighs, and back. Within each anatomic zone, the bony framework, the muscles, fatty layer, and skin should be assessed to determine how each of these components affects the contour. Ultrasound can be used to determine the thickness of the subcutaneous envelope in each region and plan the quantity and location of the fat graft in each subcutaneous space as well as any areas of adhesion that should be released.

Digital imaging which can simulate the patient's possible postoperative shape is helpful to show the patient the effects of liposuction, fat shifting, and fat grafting. It is even more useful in managing expectations and showing the patient what is not possible. If the patient has requested a very large volume result, digital imaging can illustrate what is reasonable and safe and open a discussion on staging the procedure. Patients interested in large-volume results that would be best served with staged procedures can be shown where fat can be left undisturbed and ready for harvest in a second round of fat harvest and grafting.

Once the final operative plan has been decided, the surgeon should discuss the recovery, expected fat resorption rates, and limitations on postoperative activity.

Surgical Equipment and Setup

Intraoperative Ultrasound Systems

Over the past 7 years, the author has used five different ultrasound systems with gluteal fat grafting. Real-time intraoperative ultrasound can actually be used with any cannula or liposuction/fat grafting system. However, when a syringe fat grafting system is used, both of the surgeon's hands are occupied. One hand must hold the syringe while the other hand pushes the plunger to inject the fat. In this scenario, the

surgical assistant or scrub tech must control the sterile ultrasound probe, making coordination with the injecting surgeon difficult. To allow the surgeon to control the fat grafting system and the ultrasound probe simultaneously, a power-assisted liposuction system (PAL, MicroAire Charlottesville, VA) is used in conjunction with a peristaltic pump for controlled propulsion of the fat graft. In this manner, the surgeon can inject fat via expansion vibration lipofilling [18] with one hand and control the ultrasound probe with the other hand.

Currently, two ultrasound systems for real-time intraoperative ultrasound are being used: the Clarius ultrasound (Clarius, $6400) or the Butterfly iQ (Butterfly, $1999 with $420 annual subscription) (Figs. 10.3 and 10.4). The Clarius is a 4–13 Mhz high-frequency linear L7 portable, waterproof, wireless ultrasound probe (maximum depth of 7 cm) that can be placed entirely in a sterile probe cover and can stream a high-resolution ultrasound video to Apple iOS or Android tablets. The Butterfly iQ is a

Fig. 10.3 The Clarius ultrasound probe is a 4–13Mhz high-frequency linear L7 portable, waterproof, wireless ultrasound probe (maximum depth of 7 cm) that can be placed entirely in a sterile probe cover and can stream a high-resolution ultrasound video to Apple iOS or Android tablets

Fig. 10.4 The Butterfly iQ ultrasound probe is a new generation probe that uses microchips rather than piezoelectric crystals to generate and interpret ultrasound waves. This is a wired system that is currently compatible with iOS devices

wired ultrasound probe that connects to Apple iOs iPhones or iPad tablets. Both the Clarius and Butterfly systems will upload their data to the cloud so that ultrasound still images and video can be accessed on a computer or added to a patient chart.

Fat Trap Canister

It is preferable that the fat graft remain in a liquid state for smooth propulsion through our peristaltic pump system. A fat trap within the liposuction tubing circuit is used to collect the fat that has been aspirated. This trap or canister is connected by liposuction tubing between the harvest cannula and the liposuction machine/suction source. Many canister models are available and have been tried, but the simplest one is preferred – a reusable plastic canister with a lid and no openings or spigots at the bottom [19]. For a fat grafting procedure using a peristatic pump and the MicroAire system, two different types of liposuction tubing are necessary. Standard liposuction tubing (both ends with large openings) (PSI-TEC Tubing, Ref PT-5558, Mentor, Irving, TX) is used to connect the suction source to the canister lid. MicroAire tapered tubing (Ref PAL-1200, MicroAire, Charlottesville, VA) is then used to connect the other port on the canister lid to the MicroAire liposuction cannula. When harvesting fat, a vacuum is established through the tubing and any aspirated fat is captured within the canister. The lipoaspirate that is collected is allowed to separate with gravity and time to allow the fat to separate from the tumescent fluid. Openings

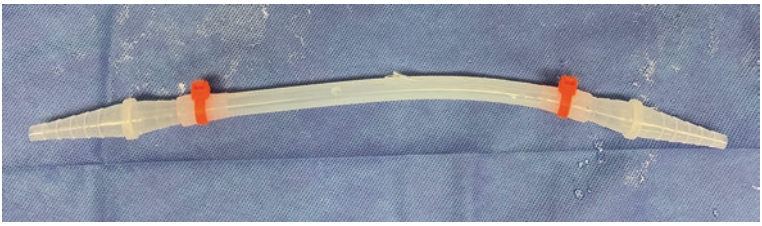

Fig. 10.5 Sterile silicone insert kit connects the standard liposuction tubing (two large openings) with the MicroAire tubing (one large opening, one tapered opening) and the silicone insert is then placed into the peristaltic pump. The surgeon can control the flow of the fat graft with a foot pedal connected to the peristaltic pump

or spigots at the bottom of the fat trap canisters act as chokepoints in the fat grafting system during EVL and are not recommended.

Peristaltic Pump for Fat Grafting

A peristaltic pump system is used for infiltration of the tumescent fluid and for controlled fat grafting via EVL, as well. A sterile tubing insert kit [20] is used to connect the two different liposuction tubings used in fat harvesting. This kit provides a silicone tubing insert that will be placed in the peristaltic pump to propel the fat graft from the canister through the tubing and out the MicroAire cannula during EVL (Fig. 10.5).

Surgical Technique

Liposuction of the torso and fat grafting to the gluteal areas and hips is designed to be an outpatient procedure performed under general anesthesia. Specific types of anesthesia do not effectively protect the patient from fatal complications such as fat pulmonary emboli. What does protect the patient is ensuring that there is no intramuscular fat injection. Ultrasound visualization can continuously confirm the real-time position of the cannula tip and keep the patient safe. The ultraBBL is performed under general anesthesia to facilitate comfortable controlled extraction of deep and superficial fat and for maintenance of the airway when the patient is in the prone position.

Circumferential Sterile Prep of the Patient Post-Induction

The surgical prep and draping is important as it provides a sterile field with circumferential access to the torso and permits safe position changes without the use of a bean bag, redraping, the use of an extra stretcher, or extra staff. The position changes

can be performed without breaking sterility in under 30 seconds. This prep and draping technique is now used in all of our body contouring procedures allowing circumferential treatment of every torso.

The patient never receives a standing prep because sterility is usually broken by the time the patient has climbed onto the operating table. More importantly, a standing prep is extremely uncomfortable for the patient and the operating room staff. The minutes before induction are important for the patient's perception of the procedure and are usually the only thing they remember about the surgery. All of our cases begin with the patient supine as anesthesia is being induced followed by intubation. Sequential compression devices are placed on both legs. A Foley catheter is placed and taped securely to the left inner thigh and left inner calf of the patient. The Foley passes off the OR table between the patient's feet. This is important as securing the Foley in this manner will prevent nerve compression injuries or urethral traction injuries during the multiple position changes.

The surgical team (four people including the sterile surgical tech, the non-sterile circulating nurse, the anesthesia provider, and the non-sterile surgeon) circumferentially preps the patient. The surgical tech begins by rolling a sterile table cover with an impermeable surface (44″ × 90″, Ref 8377 Cardinal Health, Waukegan, IL) to the midpoint and holds the rolled edge superiorly.

The surgeon is standing on the left side of the patient and places the patient in the left lateral decubitus position facing the surgeon while the anesthesia provider secures the endotracheal tube and supports the head to keep the neck in a midline position. Lateral and prone support for the head and neck is maintained with a square anesthesia head pillow. (Wilson Foam Frame Kit, REF FP-WILSON Cardinal Health Waukegan, IL). The circulating nurse then preps the patient (any prep is acceptable; Betadine will be used in this description) beginning with the anterior abdomen at the umbilicus, over the right waist and flanks, and down to the entirety of the exposed back down to the surface of the operating room table. Once the back has been prepped, the surgical tech places the rolled edge of the sterile table cover on top of the exposed operating room table and pushes the rolled drape as far under the patient as possible. The surgical tech places a halfway rolled blue towel on top of this drape at the level of the pelvis. This blue towel will be used to lift the patient during all position changes. The area that the nurse has just prepped is now sterile and this sterile surface will lie on the sterile under body drape in the next step.

At this time, the patient is returned to the supine position and the entire prepped back and right side is now resting on the sterile under body drape. The surgeon and the circulating nurse now switch sides around the operating room table and the surgeon now places the patient in the right lateral decubitus position, rolling the right side, flanks, waist, back, and thighs that have previously been prepped onto the sterile drape. The left side, flanks, waist, back, and thighs are now exposed and facing up and are ready to be prepped. The circulating nurse now preps the left torso. With the patient in this position, the surgical tech unrolls the underbody drape and blue towel to cover the operating room table and arm board. At this point, both of the patient's sides, flanks, waist, thighs, and back are sterile and are laying on top of a sterile underbody drape. The patient is finally returned to the supine position

where the circulating nurse now preps the anterior abdomen and sides from one edge of the table to the other.

Blue towels are secured with staples to cover the genitalia, both thighs and breasts. A three-quarter drape (56″ × 76″, Ref 29350 Cardinal Health, Waukegan, IL) is placed across the patient's lower body from the mid thighs to the feet. An extra large drape (77″ × 98″ REF 9444 Cardinal Health, Waukegan, IL) is used to cover the upper body and arm boards. During the position changes, the patient will rotate freely under the drapes so the paper drapes are not secured to the patient or the operating room table. In this way, the patient's torso can be accessed circumferentially and repositioned without changing the drapes or breaking sterility.

Liposuction and Liposculpture

Surgeons often struggle with identifying the endpoint in liposuction. Some surgeons record the volume removed from one side and match this to the contralateral side. Other surgeons count the minutes of liposuction or VASER liposelection in one treatment area and match it to the contralateral side. We must keep in mind that ultimately, liposuction is sculpture. A sculptor does not weigh the amount of stone removed from one side and continues to chisel the opposite side until the same amount of stone has been removed. Like all sculpture, our liposuction surgical endpoint must be anatomic and symmetric.

The anatomic endpoint of liposuction should be to achieve a consistent thickness of the skin fat flap throughout the torso and to ultimately create the specific anatomic shape the patient requested. This process begins before surgery when the skin and fat thickness in all treatment areas are assessed and asymmetries are highlighted. A strategy should be in place to differentially remove fat until the flap has a consistent thickness.

The incisions used for liposuction and fat grafting of the torso are designed to access all treatment areas and are placed in inconspicuous locations. On the anterior abdomen, one incision is placed inside the belly button at the 12 o'clock position. An incision in each inguinal crease is also made to access the anterior abdomen, lateral abdomen, and waist and thighs. Posteriorly, two supragluteal incisions, two infragluteal incisions, and one intergluteal incision are created (Fig. 10.6).

Once the patient is prepped and draped, three access incisions are made in the anterior abdomen – one inside and at the bottom of the umbilicus and two inguinal incisions, each just under the bikini line. Skin protectors are placed within each incision to minimize abrasions and skin trauma. Tumescent fluid consisting of 1 liter of normal saline and 1 ampoule of epinephrine (final epinephrine concentration of 1:1,000,000) is warmed and used in all treatment areas. A typical ultraBBL case uses approximately 4000–5000 cc of tumescent fluid. Tumescent fluid is infiltrated into the treatment areas using the SST (simultaneous separation and tumescence) technique via the MicroAire system using a 3 mm exploded basket cannula [18]. As

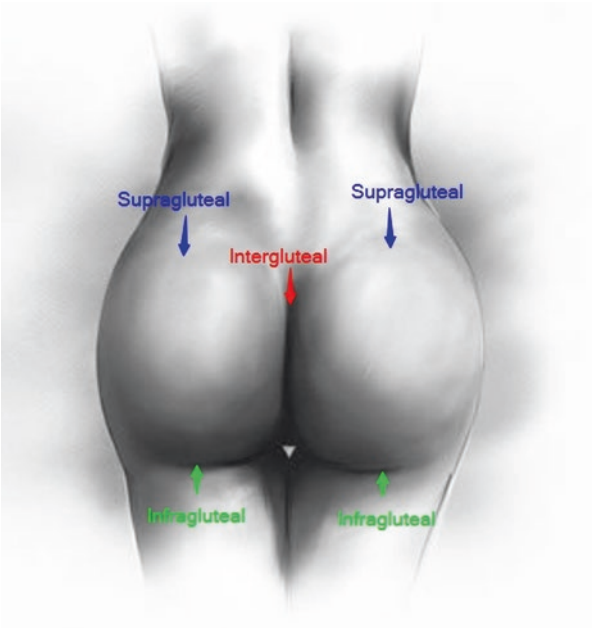

Fig. 10.6 Posterior gluteal access incisions: the supragluteal incisions are used for fat harvest of the back, waist, hips, flanks, and sides as well as fat grafting to the central dome and superior outer hip. The intergluteal incision is used for fat harvest of the back, along the lower latissimus dorsi and for contouring the superior buttock as well as fat grafting to the dome and the supragluteal region. The infragluteal incisions are used for fat harvest, fat shifting, and fat grafting to the outer hips and thighs

Del Vecchio and Wall described, this allows for the separation of subcutaneous tissue and a more rapid onset of the epinephrine vasoconstriction.

More importantly, fat separation is the crucial concept in body contouring [7]. When performing body sculpting, deformities are only created under suction. A deformity cannot occur when fat is displaced or separated without suction. For this reason, it is recommended to separate the fat as much as possible before suction is applied. Fat separation with a 5 mm exploded basket cannula after the infiltration of tumescent fluid and before fat extraction with suction allows the epinephrine to continue working, releases fibers and adhesions, allows for easy subsequent extraction, and creates small fat grafts that can fill and correct small local irregularities. Fat separation continues until the cannula can move through the treatment area without resistance. No suction has been applied up to this point. Once the separation phase has been completed, fat extraction under suction may begin. Extraction begins deep, at a level just over the fascia, and continues superficially until the desired thickness of the skin fat flap and the desired anatomic contour has been achieved.

Our goal is to extract fat until a 1.5–2 cm thickness of the skin fat flap is achieved throughout all treatment areas. Large cannulas do not cause irregularities and cannula track marks. These deformities occur when fat is torn from the surrounding tissue under suction. A 5 mm exploded basket cannula is used for fat separation and fat harvest. A large exploded basket cannula works very well for fat separation but any cannula can be used for fat extraction. Although a large cannula can be used for fat extraction, deformities and cannula track marks do not occur because the fat was

never torn out with suction – the fat had been separated without suction during the separation phase and only the loose fat was removed with suction.

To create a uniform thickness of this skin fat flap circumferentially around the torso, we begin by establishing this thickness first on one side of the patient's waist and flanks and then matching this thickness on the contralateral side and, finally, matching this skin fat flap thickness throughout the anterior abdomen and throughout the back. Therefore, every procedure begins with the patient in the lateral decubitus position, as this allows for inferior displacement of the abdominal contents and access to the deep fat of the waist, flanks, lower back, as well as the left costal margin and the left lateral anterior abdomen.

The procedure begins with the patient in the right lateral decubitus (left side up) position. The supragluteal and intergluteal incisions are used to access the left outer thigh, hips, waist, flank, lower back, costal margin, and lateral anterior abdomen. Once these areas have been tumesced and the subcutaneous tissue has been separated without suction, the fat is then harvested under suction. Once the left side has been completed, the patient is then placed into the left lateral decubitus (right side up) position and the right outer thigh, hip, waist, flank, lower back, right costal margin, and the right lateral anterior abdomen are tumesced and receive fat separation without suction, and, finally, the loosened fat is extracted with suction. This continues until the skin fat flap thickness on this side matches the contralateral side. At this time, the patient is returned to the supine position and the anterior abdomen is treated until the thickness of the skin fat flap of the anterior abdomen matches the sides. If the patient requested liposculpture or abdominal etching, it is performed at this time. The inner thighs can be addressed in the supine position, as well. When all fat extraction has been completed, drains are placed through the inguinal incisions and sutured securely, and the patient is placed in the prone position. Once the patient is in the prone position, we check the peak inspiratory pressure and if a marked increase is noted compared to its supine value, chest rolls may be placed longitudinally along the lateral chest. In our experience, this is necessary in less than 1% of cases. The prone position is ideal to treat the bilateral lateral back, lower back, sacral area, and supragluteal contour. All areas will be tumesced, receive fat separation without suction, and loose fat removal under suction until the skin fat flap thickness has been reached and our planned anatomic contours have been achieved. The patient is now ready for real-time intraoperative ultrasound-guided fat grafting.

Fat Grafting Using the MicroAire System

The Multi-Society Task Force for Safety in Gluteal Fat Grafting recommended a rigid cannula greater than 3 mm in diameter to avoid inadvertent arcing or bending of the cannula as it is pushed through the gluteal tissue. They also warn of the bending at the luer interface of many cannulas and recommend a more rigid system [7, 13]. More importantly, if the surgeon uses one hand to hold the body of a syringe

Fig. 10.7 A "candy cane" cannula (Helix Tri-Port III, MicroAire) is used for fat grafting because the multiple openings avoid clogging by the fat graft and having all openings on only one side of the cannula allows for precise directional fat grafting

and the other hand to push the syringe plunger during injection, the surgeon does not have a free hand to palpate the tip of the cannula during fat grafting. For these three important reasons, the author recommends using a power-assisted liposuction system (PAL, MicroAire Charlottesville, VA) paired with a peristaltic pump to propel the fat graft during injection, better described as expansion vibration lipofilling (EVL) [18]. To allow for smooth, controlled propulsion of the fat graft through the tubing system, the fat graft should be liquid. After fat harvest, the lipoaspirate is allowed to settle via gravity and the bottom aqueous portion is extracted, leaving a still fluid lipoaspirate for fat grafting.

To minimize supplies and costs, the tubing already used for fat harvesting will be spliced together and reused for fat grafting. The liposuction tubing (both ends with large openings) (PSI-TEC Tubing, Ref PT-5558, Mentor, Irving, TX) is connected to the silicone insert tubing kit and then connected to the MicroAire tubing (one large end and one tapered end) (Ref PAL-1200, MicroAire, Charlottesville, VA). Once connected the large end of the liposuction tubing is placed into the lipoaspirate canister, the silicone insert is placed into the peristaltic pump, and the tapered end of the tubing system is attached to the MicroAire cannula which will be used for fat grafting.

Different cannulas can be used for fat grafting. The author prefers a "candy cane" cannula (Helix Tri-Port III, MicroAire) because the multiple openings avoid the single hole obstruction of other cannulas and having all openings on one surface allows for precise directional fat grafting in the subcutaneous space (Fig. 10.7).

Fat grafting is performed under real-time intraoperative ultrasound guidance through the intergluteal and supragluteal access incisions. The infragluteal access incision is only used for addressing the outer thighs and hips.

Real-Time Intraoperative Ultrasound Visualization of Fat Grafting

All gluteal preoperative markings are reinforced including the horizontal line marking the point of greatest hip projection (at a level bisecting the intergluteal crease), as well as other areas that will require volume, adhesion release, correction of asymmetries, etc.

An Android or iOS tablet is mounted on an IV pole facing the gluteal area and the surgeon. The portable wireless ultrasound probe and a Bluetooth computer mouse are placed into a sterile probe cover (6″ × 48″ Soft Flex Probe Cover REF

20-PC648 Advance Medical Designs Marietta, GA) and brought onto the field. The ultrasound probe is placed on the skin over the first treatment area (central mound) and the sterile computer mouse is used to adjust the ultrasound probe's depth of field, gain, mode, and contrast. Recording of the ultrasound-guided fat grafting procedure begins.

The surgeon will hold the MicroAire handle and cannula with one hand, the ultrasound probe with the other hand to visualize the cannula tip and control the propulsion of the aqueous fat graft with a foot pedal.

The order of gluteal fat grafting begins centrally to establish projection over the central gluteal dome, then laterally to the hips, and, finally, into the supragluteal and medial gluteal regions. The cannula is inserted through the supragluteal or intergluteal incisions and advanced into the treatment zone until it is visualized by the ultrasound. To create significant central dome projection, the cannula tip is placed with ultrasound guidance into the deep subcutaneous space (under the superficial gluteal fascia and above the deep gluteal fascia) and fat graft is precisely injected. The cannula tip is always visualized, and care is taken never to place the cannula tip below the deep gluteal fascia as this would result in an intramuscular injection. Any adhesions within the deep subcutaneous space can be visualized and released allowing for even distribution of the fat graft throughout this zone. To correct superficial skin depressions and asymmetries, the superficial subcutaneous space (above the superficial gluteal fascia and below the skin) is specifically addressed. Ultrasound-guided fat separation and release of adhesions is first performed in the superficial subcutaneous space followed by controlled fat injection. Care is taken to keep the superficial gluteal fascia intact as this will maintain separate deep and superficial subcutaneous spaces and prevent blowout irregularities. In this manner, the two anatomical subcutaneous spaces can be individually addressed in each anatomical area (Figs. 10.8, 10.9, 10.10, 10.11, 10.12, 10.13, 10.14, 10.15, and 10.16).

Real-time intraoperative ultrasound-guided fat grafting allows the surgeon to consistently avoid penetrating the deep gluteal fascia and prevent an inadvertent intramuscular fat graft injection. It also lets the surgeon accurately manipulate the structures of the subcutaneous region and to precisely fat graft into the deep or superficial subcutaneous spaces. Ultrasound video of the entire fat grafting process can easily be created to serve as definitive documentation that at no time was there an intramuscular injection. Real-time intraoperative ultrasound allows for precise fat grafting into the subcutaneous spaces and can keep the patient and the surgeon safe.

Patient Cases

Case One

A 42-year-old G1P1 Hispanic female presents with lipodystrophy of the abdomen, waist, sides, flanks, and thighs and loss of volume, asymmetry, and ptosis of the gluteal areas and hips, bilaterally. The patient stated that she would like the lipodystrophy

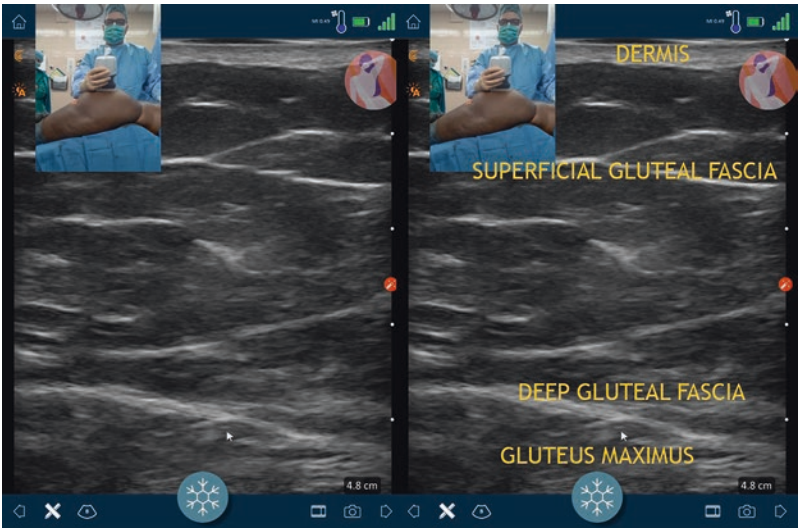

Fig. 10.8 Central dome preinjection: the Clarius portable wireless ultrasound probe is placed over the central dome of the buttock. The probe is transmitting the image to the tablet that is facing the surgeon. The dermis, superficial gluteal fascia, deep gluteal fascia, and gluteus maximus are noted. The superior surface of the gluteus maximus is covered with the deep gluteal fascia and is 4 cm below the skin in this patient. Each white dot along the right side of the image is 1 cm from the surface of the probe. Before injection the superficial gluteal space (below the skin and above the superficial gluteal fascia) in this patient is approximately 1.5 cm thick. The deep gluteal space (below the superficial gluteal fascia and above the deep gluteal fascia) is approximately 2 cm thick before injection

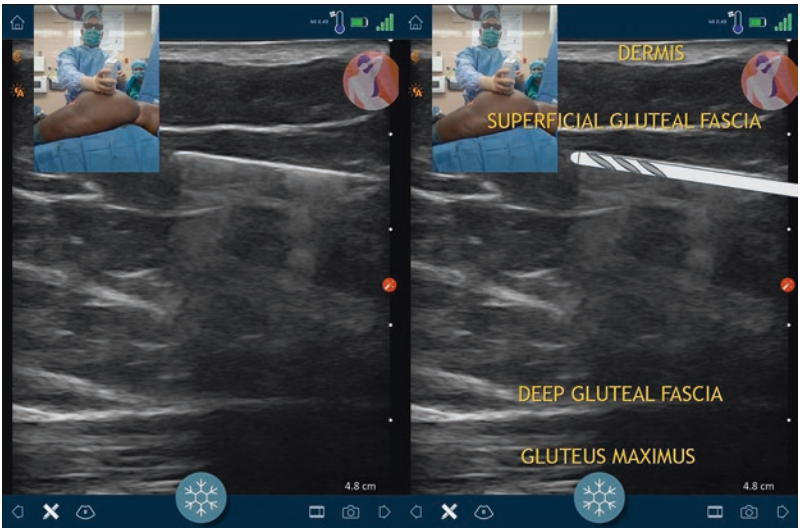

Fig. 10.9 Central dome with fat grafting cannula in deep gluteal space: the "candy cane" fat grafting cannula is directly beneath the superficial gluteal fascia and is facing inferiorly. It is displacing the superficial gluteal fascia superiorly to allow for expansion of the deep gluteal space. The deep gluteal fascia and the gluteus maximus are noted to be 4 cm below the skin surface

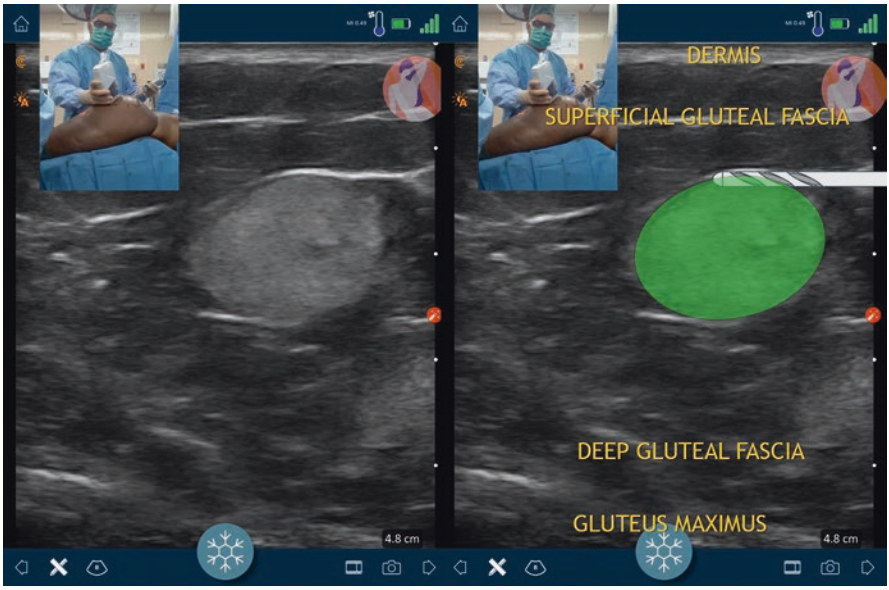

Fig. 10.10 Central dome fat graft exiting the cannula. Fat grafting begins with the aqueous fat graft (light gray hypoechoic bubble) leaving the inferior surface of the "candy cane" cannula under the superficial gluteal fascia and within the deep subcutaneous space

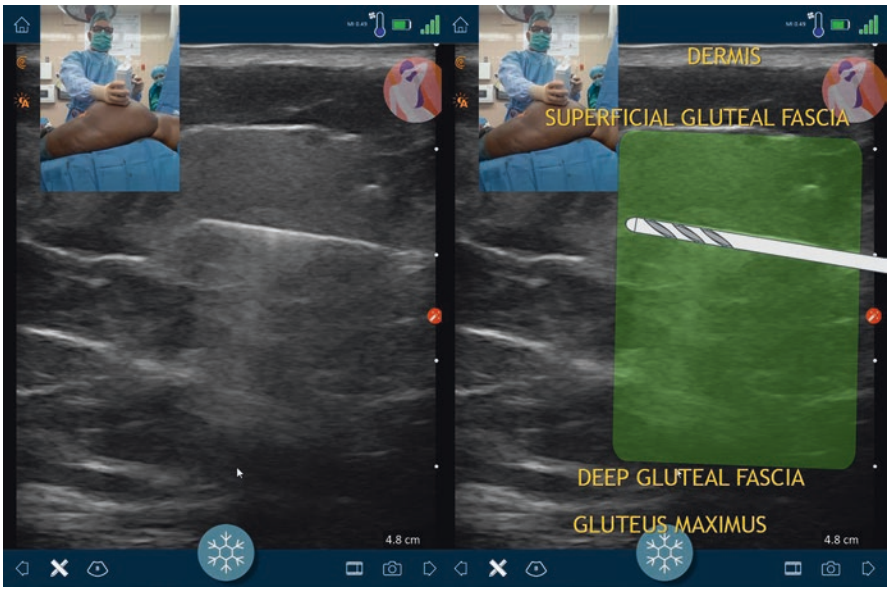

Fig. 10.11 Central dome fat graft expanding the deep subcutaneous space. Fat graft began with the "candy cane" cannula just underneath the superficial gluteal fascia. As the upper part of the deep gluteal space is filled, the cannula is lowered half a centimeter to fill and expand the deep gluteal space

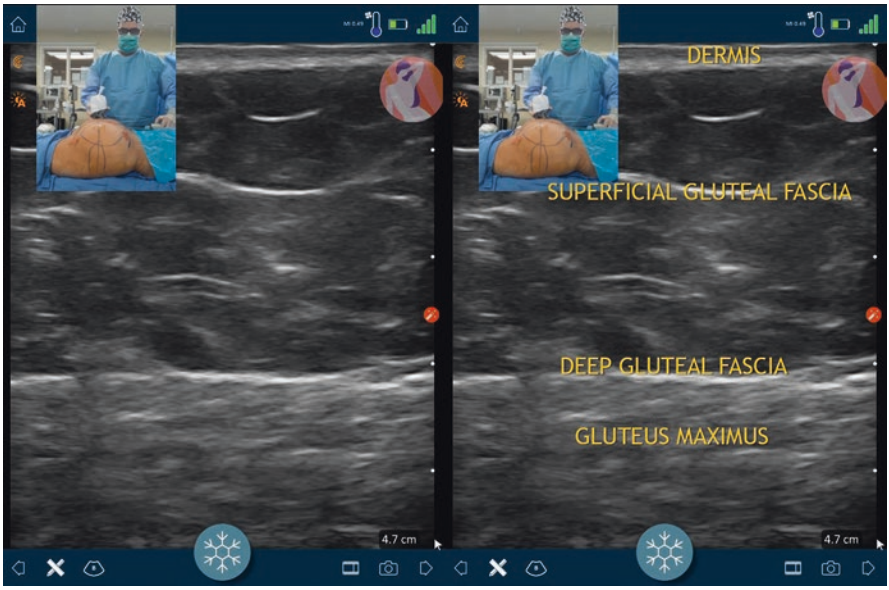

Fig. 10.12 Central dome with cannula under superficial gluteal fascia, Example 2. In this different patient, both fascias are visible. Before injection, the superficial subcutaneous space is 1.4 cm thick, the deep subcutaneous space is 1.6 cm thick, and the deep gluteal fascia is 3 cm below the skin

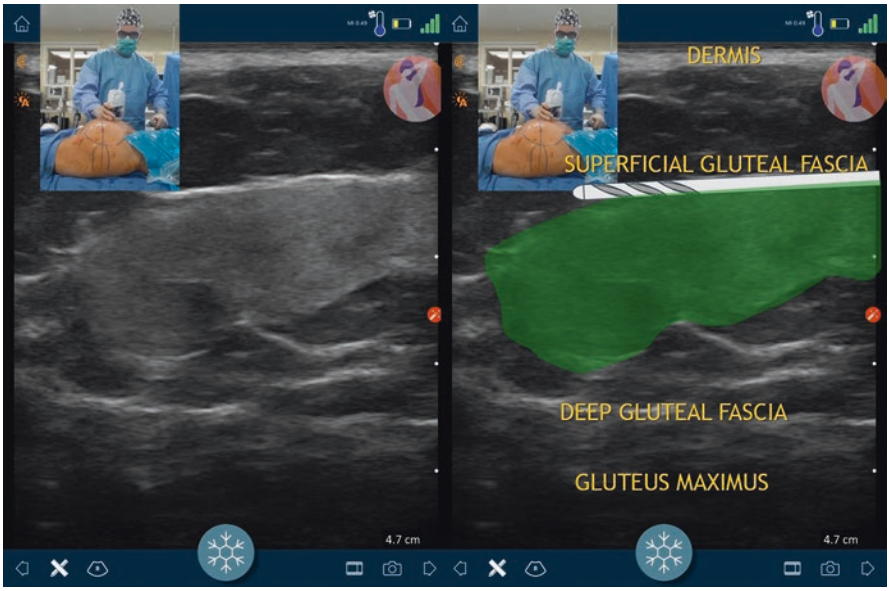

Fig. 10.13 Central dome, Example 2. The "candy cane" cannula is inserted just underneath the superficial gluteal fascia and is facing inferiorly. The deep subcutaneous space is filled from the top down. The superficial gluteal fascia remains intact and retains the fat graft beneath it like the casing of a sausage

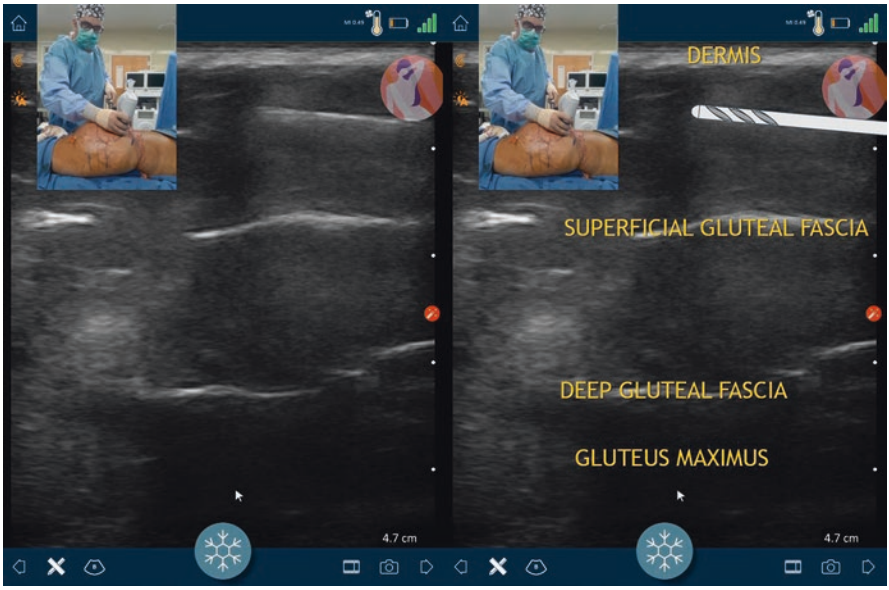

Fig. 10.14 Supragluteal contour, preinjection. The "candy cane" cannula is above the superficial gluteal fascia within the superficial subcutaneous space. Ultrasound guidance allows for precise targeting of thin subcutaneous spaces

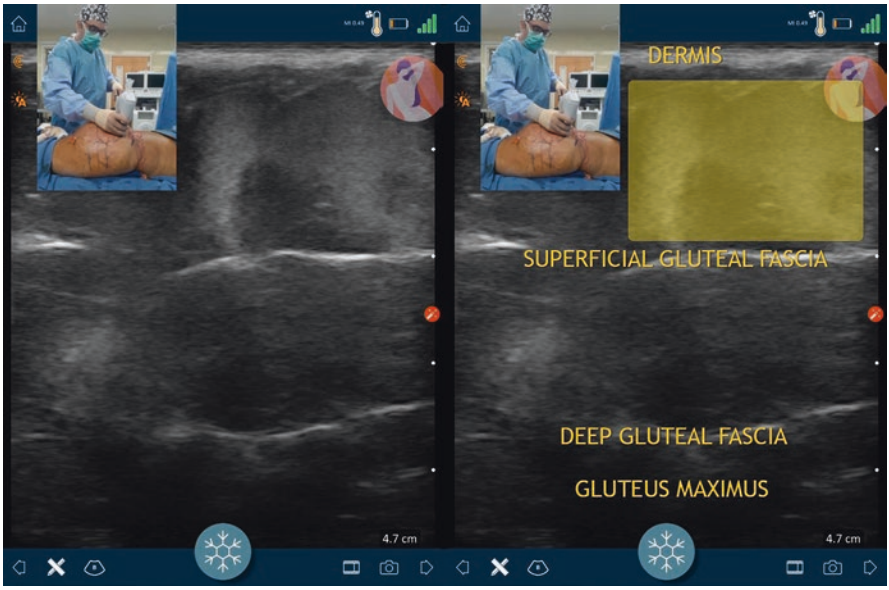

Fig. 10.15 Supragluteal contour, after fat graft. Fat graft has expanded the superficial subcutaneous space from 1.7 to 2 cm. The deep gluteal space remains unchanged

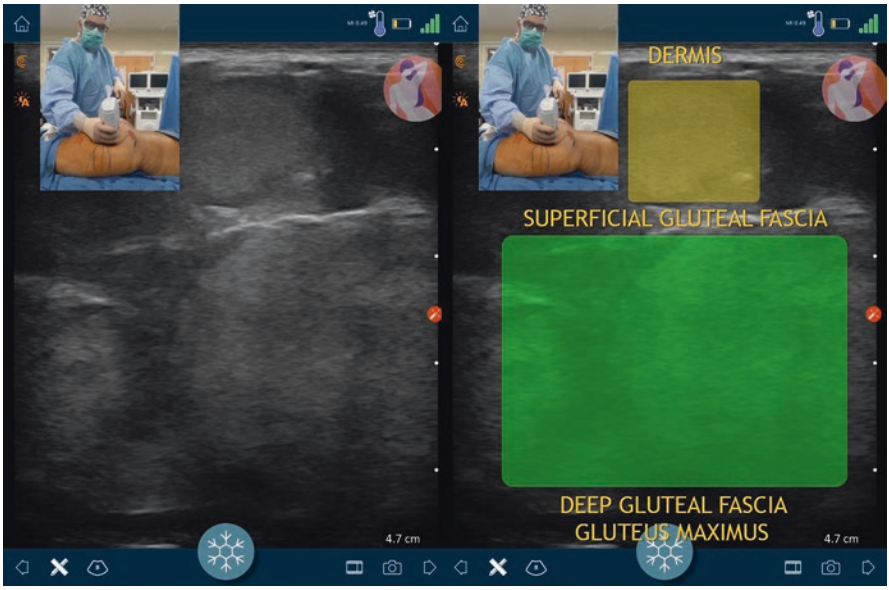

Fig. 10.16 Outer hips, after fat grafting to both spaces. Fat graft has expanded the superficial subcutaneous space and the deep subcutaneous space. This is essential when filling the outer hips

of her abdomen and back correct, as well as a rounder and fuller gluteal contour. Patient was evaluated on physical exam and it was noted that she had significant lipodystrophy of the anterior abdomen, waist, flanks, lower back, and sacral area as well as depressions and volume loss of the outer hips and gluteal ptosis.

Patient's Priorities

The patient stated that she would like to extract as much fat from the anterior abdomen, waist, and flanks as possible. She also stated that she would like a low waist to hip ratio (less than 0.6) and would like to fill the lateral gluteal hollows.

Operative Challenges

Fibrous tissue of the back and sacral area may make fat separation and extraction difficult in these important anatomic areas. Outer hip contour after fat grafting will rely on survival of the fat graft, making achieving the desired waist to hip ratio with outer hip fat grafting alone difficult (Fig. 10.17).

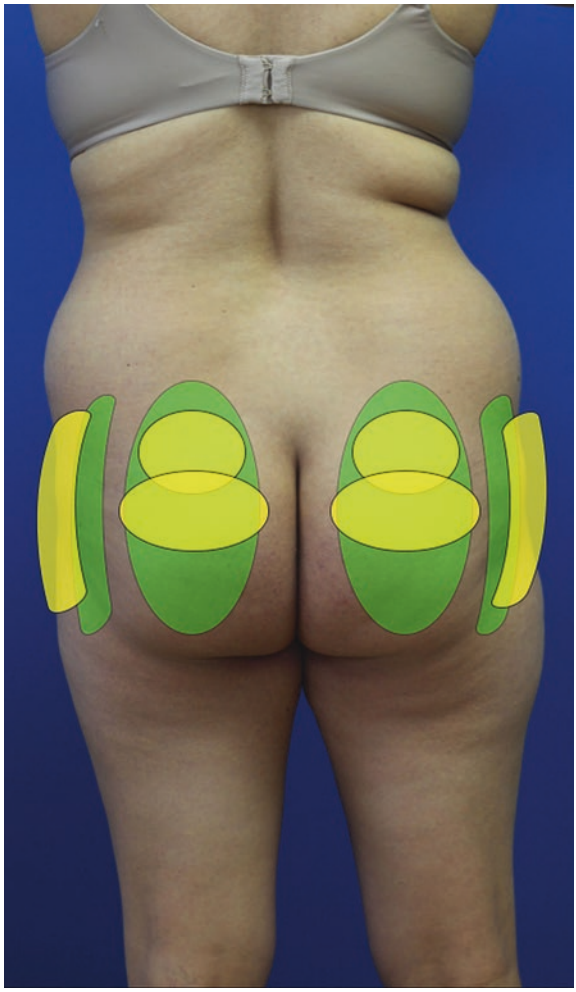

Fig. 10.17 ultraBBL CASE 1: ULTRASOUND-GUIDED FAT GRAFTING PLAN. Gluteal fat grafting was planned to the deep subcutaneous spaces (GREEN) to increase projection and add volume. Fat grafting to the superficial subcutaneous spaces (YELLOW) would supplement the deep volume and correct superficial irregularities

Surgical Plan

- Fat separation without suction to all areas, followed by fat extraction under suction.
- Deep space fat grafting to the central domes, supragluteal area, and outer hips at the point of greatest projection.
- Superficial space fat grafting to correct superficial concavities at the outer hips.
- To more reliably achieve the patient's desired waist to hip ratio, extract as much fat throughout the waist and flanks as possible, rather than rely on the survival of fat graft in the outer hips.

Result

The patient received an ultraBBL (ultrasound-guided Brazilian butt lift) with fat separation and fat extraction of the abdomen, waist, flanks, lower back, and sacral areas. She received 900 cc of ultrasound-guided fat graft per side. Seven hundred cc of fat graft was placed in the deep subcutaneous space (above the deep gluteal fascia and below the superficial gluteal fascia) for the creation of gluteal volume, central dome projection, and outer hip expansion. She then received 200 cc of fat graft to the superficial subcutaneous space (above the superficial gluteal fascia and below the skin) to the outer hips, bilaterally. The patient is shown with a 6-month result and is satisfied with the result (Figs. 10.18 and 10.19).

Surgeon's Analysis

Further fat extraction of the outer thighs, as well as additional deep space fat grafting to the outer hip at the point of greatest projection (midpoint of the intergluteal crease), could improve this result. When correcting outer hip tightness or skin irregularities, care must be taken to avoid overfilling the superficial subcutaneous space to prevent skin deformities or blowouts.

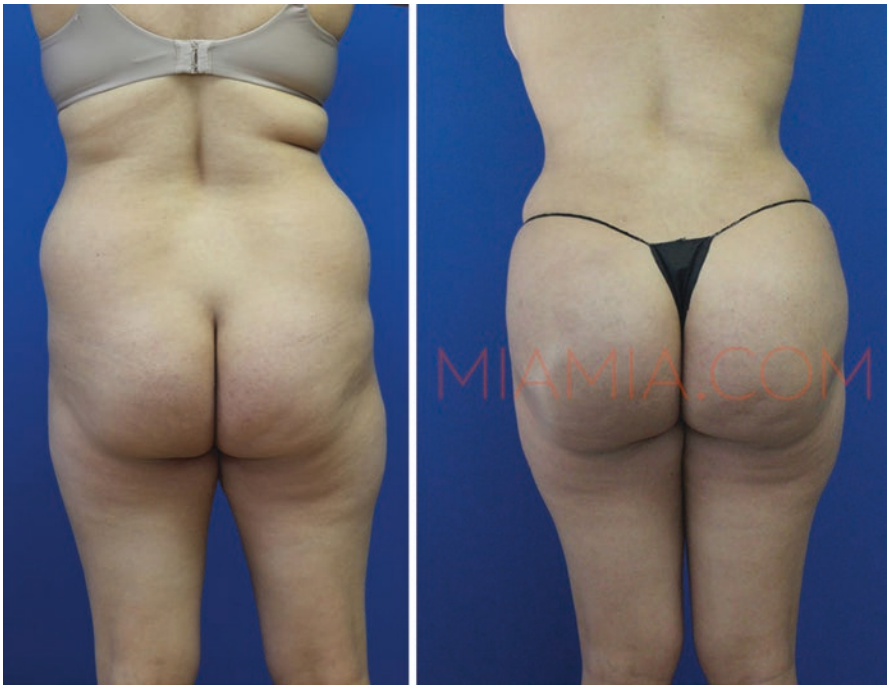

Fig. 10.18 ultraBBL CASE 1. Postoperative result at 6 months, posterior view

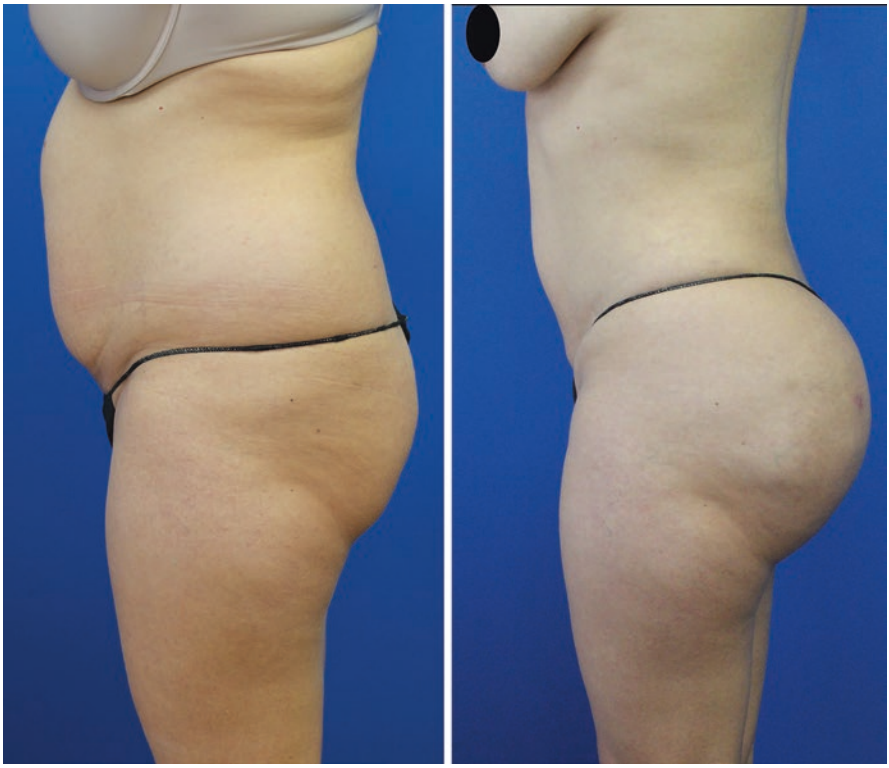

Fig. 10.19 ultraBBL CASE 1. Postoperative result at 6 months, lateral view

Case Two

A 27-year-old G0P0 African American female presents with lipodystrophy of the abdomen, waist, sides, flanks, and thighs and loss of volume, asymmetry, and ptosis of the gluteal areas and hips, bilaterally. The patient was evaluated on physical exam and it was noted that she had significant lipodystrophy of the anterior abdomen, waist, flanks, lower back, and sacral area as well as volume loss of the outer hips and gluteal ptosis.

Patient's Priorities

The patient stated she would like to extract as much fat as possible from the abdomen, waist, flanks, and back. She also stated that she would like to maximize her gluteal volume and create a spherical contour. The patient requested a low hip to waist ratio (less than 0.6) and a high point of maximum hip projection (2 cm above the midpoint of the intergluteal cleft).

Operative Challenges

Fibrous tissue of the back and sacral area may make fat separation and extraction difficult in these important anatomic areas. Outer hip contour after fat grafting will rely on survival of the fat graft, making achieving the desired waist to hip ratio with outer hip fat grafting alone difficult. More fibrous tissue superiorly along the outer hip makes a high point of maximal projection difficult.

Surgical Plan

- Fat separation without suction to all areas, followed by fat extraction under suction (Fig. 10.20).
- Deep space fat grafting to the central domes, supragluteal area, and outer hips at a high point of greatest hip projection.

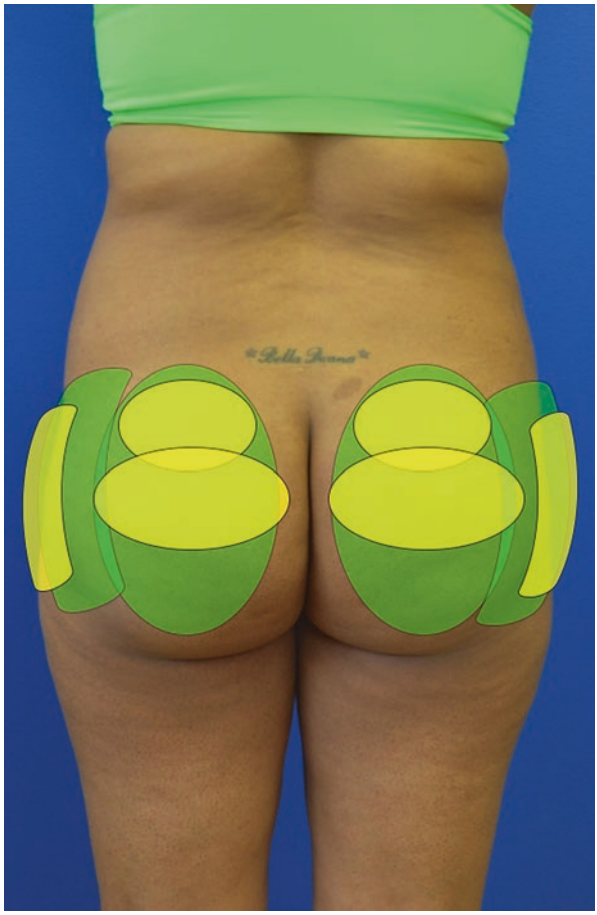

Fig. 10.20 ultraBBL CASE 2: ULTRASOUND-GUIDED FAT GRAFTING PLAN. Gluteal fat grafting was planned to the deep subcutaneous spaces (GREEN) to increase projection and add volume. Fat grafting to the superficial subcutaneous spaces (YELLOW) would supplement the deep volume and correct superficial irregularities

- Anticipate for additional adhesion release in both spaces along the outer hip before and after fat grafting for smooth graft distribution.
- Superficial space fat grafting to correct superficial concavities at the outer hips.
- To more reliably achieve the patient's desired waist to hip ratio, extract as much fat as possible throughout the waist and flanks, rather than rely on the survival of fat graft in the outer hips.

Result

The patient received an ultraBBL, a Brazilian butt lift, with fat grafting under real-time intraoperative ultrasound visualization. The patient received fat separation without suction and fat extraction under suction of the abdomen, waist, flanks, lower back, and sacral areas. Care was taken to empty the waist and flanks and the suprasacral triangle concavity. She then received 1000 cc of fat graft per side. Seven hundred cc of fat graft was placed in the deep subcutaneous space (above the deep gluteal fascia and below the superficial gluteal fascia) for the creation of gluteal volume, central dome projection, and supragluteal contour. Release of adhesions throughout the deep and superficial gluteal spaces at the outer hips was performed, taking care to leave the superficial gluteal fascia intact. She then received 300 cc of fat graft to the superficial subcutaneous space (above the superficial gluteal fascia and below the skin) at the outer hips, bilaterally. Further adhesion separation was performed after fat grafting to ensure even distribution of the fat graft in both spaces. The patient is shown with a 9-month result and is satisfied with the result (Fig. 10.21).

Surgeon's Analysis

The patient's desired waist to hip ratio was achieved more by diminishing the circumference of the torso at the waist than by the addition of fat graft to the outer hips. Once the ratio was established, fat graft could be used to emphasize the point of maximum hip projection and create a smooth transition to the upper hip superiorly and to the thigh inferiorly. Using the ultrasound to measure the thickness of the subcutaneous zones in the outer thigh could aid in fat extraction and produce a more symmetric result.

Conclusion

Gluteal fat grafting is a powerful body contouring technique that can create impressive results not obtainable with implants or liposuction alone. This procedure is very technique dependent and because of the too frequent fatal complications, it has been recommended that surgeons avoid intramuscular injection and only fat graft in the subcutaneous space above the deep gluteal fascia. The subcutaneous space, however, is a thin curving dome that ranges in thickness from 1 cm at the outer hips to 3–4 cm at the central gluteal dome. This creates a difficult target for gluteal surgeons

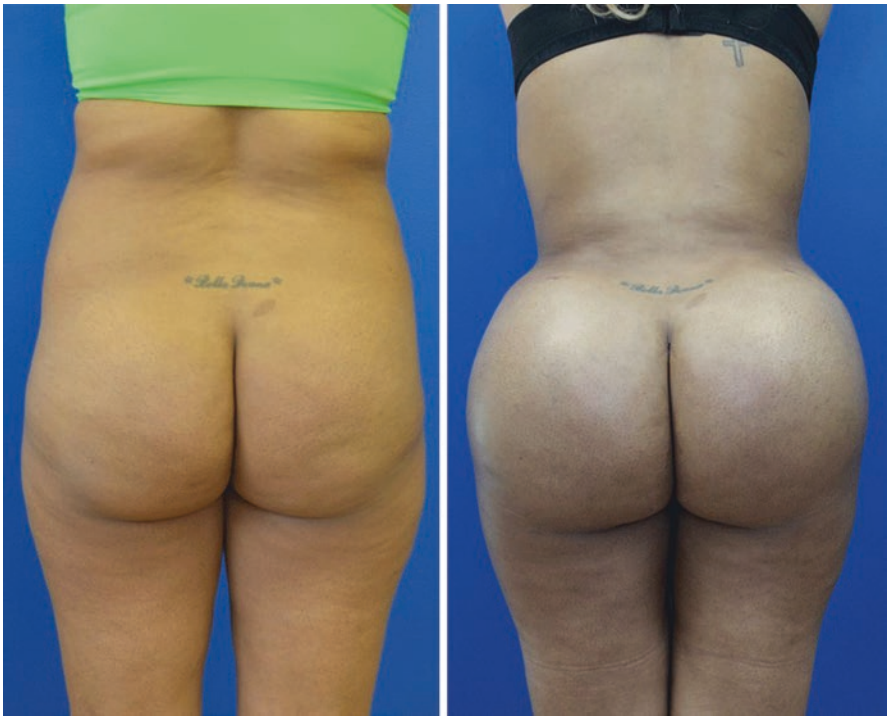

Fig. 10.21 ultraBBL Case 2. Postoperative result at 9 months

who do not use intraoperative imaging. Real-time intraoperative ultrasound-guided fat grafting allows the surgeon to consistently avoid an intramuscular injection and manipulate the subcutaneous spaces above and below the superficial gluteal fascia to precisely control fat graft volume and distribution, create projection, and correct superficial irregularities. The surgeon can also create ultrasound video of the entire procedure to document that they remained above the deep gluteal fascia at all times and analyze how their fat graft placement affected their ultimate clinical results. None of this is possible without ultrasound. Real-time intraoperative ultrasound is now an affordable tool that can work with any fat grafting system that can not only make a Brazilian butt lift more accurate and powerful, but safer, as well.

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Chapter 11
Ultrasonic Treatment of Silicone Injection Complications

Katherine H. Carruthers, Carissa L. Patete, and Christopher J. Salgado

Liquid Silicone for Soft Tissue Augmentation

Pure medical grade silicone is a synthetic long-chain organosilicon which is thought to be almost inert in nature, unaffected by heat, light, or long-term storage [1, 2]. There are many viscosities of silicone commercially available for a variety of non-medical purposes which are created by varying degrees of polymerization and crosslinking between molecules [3]. These modifications result in liquid, gel, and solid forms of silicone [1]. Due to the nature of their synthesis, silicones can be profoundly contaminated with heavy metals, volatile polymers, and other impurities that require an extensive and costly purification process which is only performed in select cases depending on the intended use for the final silicone product [4].

The injection of liquid and gel silicone for soft tissue augmentation first became popular in the 1950s for contour enhancement of the face, breasts, and body [1]. Its use was initiated in Europe and Asia before spreading to North and South America where it gained popularity in the 1960s [5]. From 1965 to 1992, the US Food and Drug Administration (FDA) conducted investigatory trials on the safety of silicone injections for soft tissue augmentation [6]. These trials were far from comprehensive, but they did shed light on the possibility that silicone injections were not as benign as originally thought [1, 7]. Thus, at the conclusion of these trials, the FDA

K. H. Carruthers
West Virginia University, Department of Surgery, Division of Plastic Surgery, Morgantown, WV, USA
e-mail: katherine.carruthers@hsc.wvu.edu

C. L. Patete
Miami, FL, USA
e-mail: c.patete@med.miami.edu

C. J. Salgado (✉)
Miami, FL, USA

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did not approve silicone in any form for injection to augment body tissues. Furthermore, they prohibited the use of any permanent injectable filler for cosmetic gluteal augmentation [7]. Despite these recommendations, its use remains controversial, and there has continued to be a market for illicitly performed silicone injections, particularly in the United States, Mexico, and Asia [8, 9].

In a recent survey by the American Society of Aesthetic Plastic Surgery, gluteal augmentation was identified as the most rapidly growing cosmetic procedure in the United States [6]. It typically involves creating a larger, firmer, and more defined buttocks using synthetic implants, autologous fat grafting, or illegally performed silicone injections [10]. Silicone injections continue to be accepted in certain cultures and communities, specifically among social groups that cannot afford traditional plastic surgery [5]. Reported rates for non-professional silicone injections range from $300 to $1600 per treatment, while the average cost for buttock implants by a licensed physician in the United States is approximately $4670 [11, 12]. Though difficult to trace these procedures, most reports indicate that patients seeking gluteal silicone injections are mostly underserved women and transgender individuals who cite poor self-image, misperceptions about silicone, and low socioeconomic status as related to their use of illegal fillers [11, 13, 14].

There is a tendency for patients seeking silicone injections for the purpose of gluteal augmentation to travel to developing countries due to the ease of international travel and the relative laxity of medical regulations in these areas [6, 14]. However, there is usually limited ability to verify the credentials of foreign practitioners and little to no record of the procedures performed [6]. Alternatively, these procedures are also being performed illegally within the United States by untrained and unlicensed personnel in unregulated nonclinical settings [4, 5, 10]. Furthermore, the material being injected is rarely pure medical grade silicone, as is claimed, and the vast majority of silicone that is injected consists of a grade of silicone that was never intended for medical use [4]. Pure sterile silicone is routinely replaced with lower cost alternatives such as food or industrial grade silicone, liquid paraffin, or petroleum jelly [7, 10, 11]. In rare cases, there have even been reports of injections consisting of cement, glue, mineral oil, tire sealant, or transmission fluid [11, 12]. Adding to the issue is the fact that new and more viscous mutations of these injections are constantly being created by adding other pro-inflammatory substances in an effort to increase the local tissue response and reduce silicone migration which occurs in response to large-volume injections [6, 13, 14]. These modified formulas are often used without the patient's knowledge and patients typically do not know the volume or purity of the products that were used [6].

Adding to the issue is the fact that truly excessive amounts of product are being injected in a single session [13]. Most injections are placed in a subcutaneous plane but some are intramuscular and reported injected volumes range from a total of 2 ounces to 8 or more liters per patient [10, 11, 13]. Injections of this magnitude can result in significant comorbidity, including silicone migration, foreign body granulomatosis reactions, and secondary fibrosis [6]. Despite these inherent risks, large-volume silicone injections for gluteal augmentation have remained popular throughout the years due to the lure of low financial cost and immediate results [7, 10, 11].

Complications of Silicone Injections

Most of the complications associated with silicone injections increase proportionally to the volume injected [10, 14, 15]. Complications can range from mild to severe and can be somewhat unpredictable, with relapsing and remitting phases [3, 6]. It is unclear whether the majority of the morbidity is associated with contaminated materials, poorly trained practitioners, excessive injected volume, incorrect placement of the filler, or a combination of all of these factors [1, 2]. Multiple other theories also exist, including the hypothesis that silicone transforms into silica, a known irritant, through its oxidation in tissue [6]. Others believe that reactions may be due to impurities in the injected material, intentional or otherwise, as silicone itself is thought to be non-immunogenic [1]. While the exact pathogenesis of the granulomatous reaction is unknown, it may involve the reactivation of a bacterial biofilms formed around the injected material [6].

Although the pathophysiology is unknown, it is understood that silicone injections promote a pathologic tissue reaction leading to sclerosing lipogranulomatosis [1, 13]. The term siliconoma was first used by Winer in 1964 to characterize this foreign body reaction [1, 3, 13]. The diagnosis can be established through a thorough history and physical exam, advanced imaging, or pathologic examination of tissue samples [1]. The presence of siliconomas is thought to be due to, in part, the size of their particles. Silicone particles are approximately 170 micrometers in diameter, which is larger than the phagocytic ability of macrophages, resulting in an inability for the host body to process silicone particles for degradation [1, 16]. Clinically, siliconomas and silicone toxicosis present as diffuse swelling with subcutaneous nodules that are firm and indurated and can be accompanied by debilitating pain, infection, or overlying skin breakdown [15, 16]. Infection initially presents as cellulitis but can quickly progress to abscess formation. Chronic soft tissue inflammation leads to hyperpigmented and thickened skin, with woody indurations and eventual tissue ulceration, as the foreign body exudes from the surrounding tissues [16, 17]. Conversely, some patients will present with severe pain in the absence of any physical findings.

Over time, complications resulting from silicone injections become more systemic in nature. Large volume silicone injections are known to migrate away from the injection site, regardless of the silicone viscosity [16]. Silicone has been found to spread to distant sites, including skin, joints, and nerves leading to polysynovitis, neuritis, and inflammation that can easily be mistaken for connective tissue disease [6]. Nonspecific symptoms can develop if the silicone migrates to the lymph nodes, including nausea, vomiting, and fever which can be difficult to diagnose [10]. Additionally, gravity can cause the silicone to migrate through the subcutaneous planes causing ptosis of the buttocks and medial thigh deformities [3, 10]. More serious complications include regional lymphadenopathy with infiltration of adjacent soft tissue and compression of surrounding organs, chronic respiratory impairment, collagen vascular diseases, sepsis, and even death [10, 15, 16].

Side effects may present immediately after injection or develop many years later [1]. Most complaints occur an average of 3–10 years following injection, but there are reports of new onset complications up to 35 years after the initial procedure [2–4, 11, 18]. It is this dramatic delay in symptom onset that has made it difficult to prove a direct correlation between silicone injections and soft tissue pathology, and most evidence comes from only case reports or case series [17]. However, there is a pattern of symptoms that is highly consistent between patients with silicone toxicosis where there are early signs of inflammation and infection followed by a latent period which can last years before the chronic effects appear [3]. Pathology has been shown to be present before patients even become symptomatic. For example, granulomatous responses to silicone injections have been demonstrated by radiotracer uptake in patients without any clinical symptoms or clinical evidence of infection [16]. Thus, it is conceivable that, once identified, some patients might benefit from prophylactic treatment in an effort to prevent the inevitable complications of silicone injections [7, 16].

Stages of Silicone Toxicosis

Patients with silicone toxicosis can be grouped into four broad categories based upon their symptomatology, their physical exam findings, and the results of their imaging studies. Staging is important for appropriately identifying and treating patients who have been effected by silicone injections, as specific treatment options are only beneficial for certain degrees of pathology [16].

Stage I

Patients deny symptoms or endorse only occasional symptoms. There are no significant findings on physical exam (Fig. 11.1). Computed tomography (CT) or magnetic resonance imaging (MRI) are rarely indicated, but if obtained, may show multiple individual foreign bodies associated with surrounding inflammation. It is recommended that patients who fall into this category are treated initially with nonsteroidal anti-inflammatory medications (NSAIDs). Medical management should only be used during periods of symptom flairs [16].

Stage IIa

Patients present with more frequent pain, in conjunction with clinically evident cellulitis or abscess formation. There may also be several palpable nodules throughout the gluteal region; however no chronic skin changes are present (Fig. 11.2). Alternatively, some patients in this category will present with significant pain but no

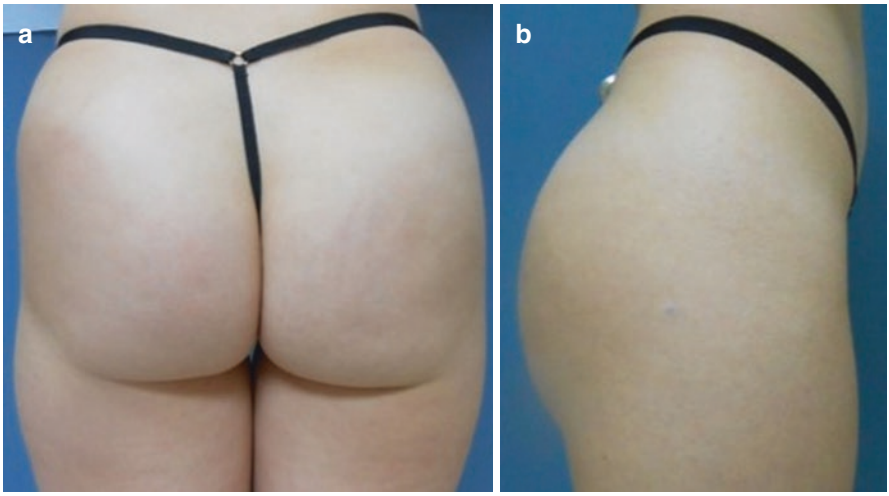

Fig. 11.1 (**a**) PA and (**b**) lateral views of Stage I silicone toxicosis. There are no significant findings on physical exam, but the patient may endorse occasional symptoms, including pain, and diffuse inflammation. Medical management with NSAIDs is the treatment modality of choice in these cases

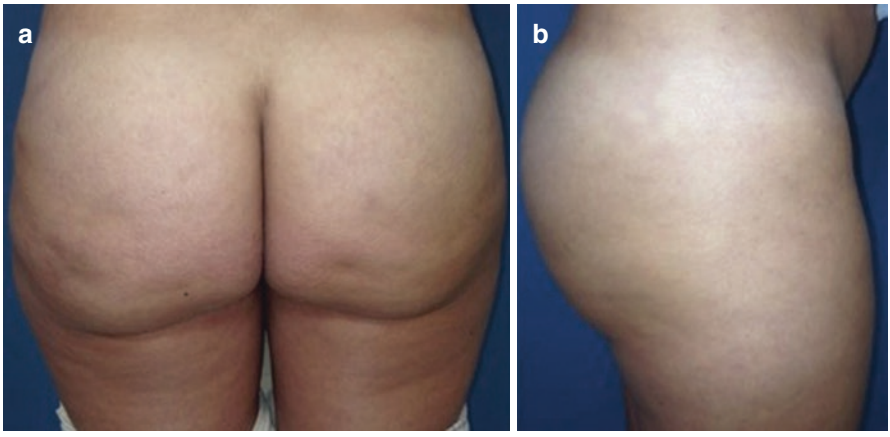

Fig. 11.2 (**a**) PA and (**b**) lateral views of Stage IIa silicone toxicosis. Several palpable nodules are present throughout the gluteal region; however no chronic skin changes are identified. Patients report frequent pain, in conjunction occasional cellulitis or abscess formation. Treatment may consist of a combination of antibiotics, anti-inflammatory agents, and immunomodulators. These patients are ideal candidates for UAL

other physical findings. They may have a history of several emergency room visits for pain control. In these cases, a computed tomography (CT) scan is recommended. Imaging typically shows multiple foreign bodies in the subcutaneous tissue with surrounding inflammation. It is recommended that these patients be treated with a combination of antibiotics, anti-inflammatory agents, and immunomodulators.

Alternatively, these patients may benefit from ultrasound-assisted liposuction (UAL) to aid in the removal of the silicone burden [16].

Stage IIb

Patients will have progression of their complaints with increasing pain, abscess formation, and worsening skin changes. Commonly, there will be diffuse erythema, palpable masses, and associated contour abnormalities (Fig. 11.3). The skin may be thinning with occasional drainage of serous fluid or oil-like material. Patients will report more frequent emergency room visits in an effort to control symptom progression. Advanced imaging is recommended and shows occasional silicone spheres or biopolymer spheres with strong inflammatory response and surrounding lymphadenopathy. These patients are also candidates for treatment with UAL but they are more challenging, as the UAL will have to occur in a deeper plane due to the degree of skin compromise [16].

Stage III

These patients are in the most advance stage of silicone toxicosis. They have dramatic visible scarring, with leather-like changes to skin, deep contour abnormalities, and chronic non-healing wounds with possible draining of silicone oil. Most

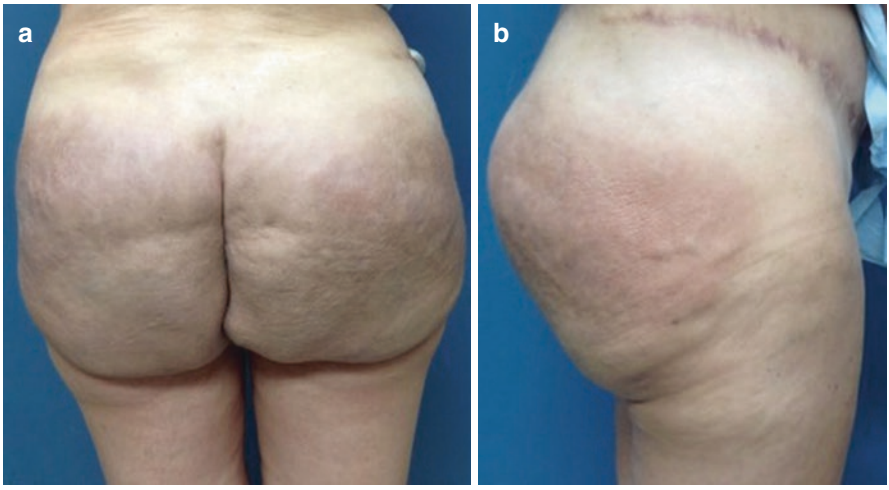

Fig. 11.3 (**a**) PA and (**b**) lateral views of Stage IIb silicone toxicosis. There is evidence of diffuse erythema, palpable masses, and associated gluteal contour abnormalities. Patients report increasing pain, abscess formation, and worsening skin changes with occasional drainage of serous fluid or oil-like material. These patients are candidates for treatment with UAL in a deeper plane due to the degree of skin compromise [16]

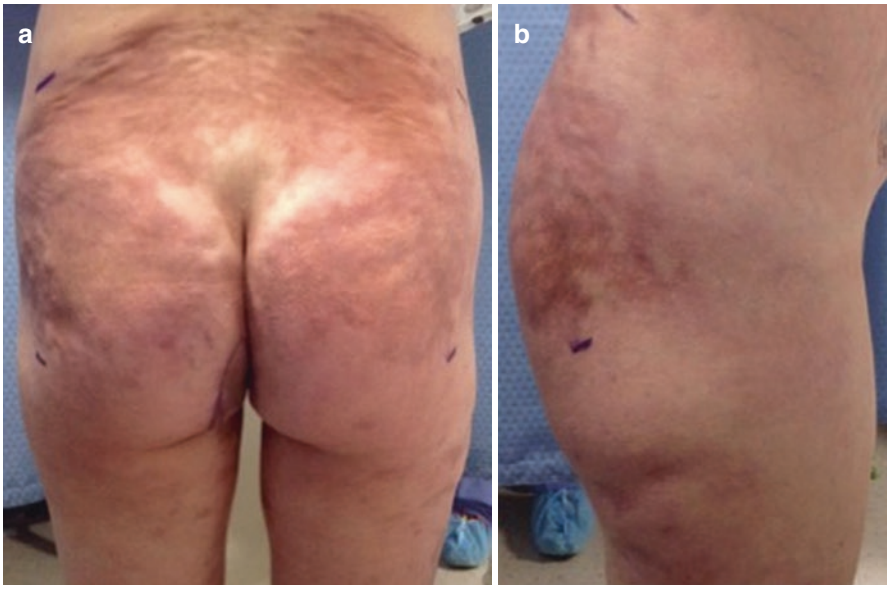

Fig. 11.4 (**a**) PA and (**b**) lateral views of Stage III silicone toxicosis. Dramatic scarring is present, with leather-like changes to skin, deep contour abnormalities, and chronic non-healing wounds which occasionally drain silicone oil. Palpable tender masses will likely still be present despite prior surgeries. Repeated surgical resection is the only treatment option for these patients

patients will have a history of prior drainage procedures. Palpable tender masses will likely still be present despite prior surgeries (Fig. 11.4). Imaging is not generally needed in these cases, as the only reliable treatment option is surgical resection. In these cases, physicians should try to position scars where they can be concealed by undergarments, as repeat surgeries are often inevitable [16].

Treatment Options

Medical management should always be attempted in patients with Stage I and IIa silicone toxicosis. NSAIDs are a good starting point for oral treatment regimens but are rarely successful in completely resolving symptoms in even the mildest of cases. Thus, combination treatments are usually employed for a multimodal approach to symptom relief. Intra-lesional steroid injections, systemic steroids, immune-modulators, and antibiotics work well in combination and are useful for temporary improvement in symptoms [1]. Systemic corticosteroids are an excellent option for tempering inflammation, but results are transient and symptoms tend to return once the patient has begun to taper the dose [7, 19]. Minocycline has been most commonly cited as a useful agent for the treatment of silicosis, as it possesses both anti-inflammatory and immunomodulating properties [1]. It is a safe and efficient way to combat the chronic inflammation of siliconomas [1]. Minocycline is typically dosed

at 100 mg twice daily, with or without the addition of a tetracycline, and had been reported to provide good results in several clinical reports [12]. The addition of the tetracycline is thought to aid the patient by combating any biofilm on the silicone spheres and augmenting the anti-inflammatory activity of minocycline on the granulomatous immune reaction [12]. If there is concern for a deep infection or progressive cellulitis, patient may need parenteral antibiotics for infection control prior to surgical intervention [3].

It is important to note that, once injected, silicone permanently resides in the tissues and surgery may be the only way to definitively treat chronic symptoms. However, traditional options for surgical resection, including en bloc excision, dermolipectomy, or suction-assisted lipectomy (SAL), can be technically difficult and have disfiguring results [10, 16]. While surgery is unquestionably indicated for patients with Stage III changes who may have deep tissue abscesses, fistulas, and fasciitis, alternatives should be considered in most other cases [3]. Standard liposuction has been suggested as an alternative to surgical excision, but it is difficult to pass a standard liposuction cannula through the inflamed tissues in a controlled fashion, and there is risk of injury to adjacent, non-affected areas with this technique [13, 16, 19]. UAL, however, performs better when faced with dense fibrotic tissues and, thus, is a good option for select cases of silicone toxicosis [16].

Specifically, patients with Stage IIa and IIb silicone toxicosis are the best candidates for UAL. UAL is a safe and effective method of removing silicone infested tissue while avoiding extensive surgical mutilation and results in minimal bleeding and less pain than traditional surgical excision or SAL [7]. Additionally, UAL of the gluteal region can be combined with SAL of the abdomen and flanks to allow for immediate intramuscular fat grafting for buttock augmentation, if desired by the patient [7]. Lipofilling can be particularly useful for patients with expected large volumes of toxin removal to prevent deflated or irregular contours following UAL [16].

Patient Selection

Candidates for UAL often have severe symptoms related to their silicone toxicosis but opt to delay their medical care in an effort to prevent the embarrassment and fear associated with admitting to receiving illicit injections [6]. It is important for physicians to thoroughly question patients with atypical symptoms when there is a concern for toxicosis, as silicone can mimic other inflammatory conditions or even malignancy and an incorrect diagnosis could result in a thoroughly mismanaged patient [6]. Patients will usually have a history of gluteal augmentation injections from a friend or acquaintance [16]. The substance is typically unknown to the patient, though they might believe it to be silicone [16]. Since patients who receive silicone injections usually place a great deal of importance on their appearance, even moderate degrees of silicone-related skin changes can cause psychological embarrassment with withdrawal behaviors [2, 6]. Furthermore, there is usually a concern that surgical excision is the only treatment option, and the fear of

permanent scarring and further deformity may cause patients to refuse treatment [6]. In these cases, UAL is just one of several alternate treatment options that should be considered [6]. However, before deciding to proceed with UAL, it is important for the physician to rule out severe and atypical infections or open wounds in the gluteal region which should be treated prior to any liposuction procedures [7, 19].

Preoperative Evaluation and Imaging

Patient Expectations

During the preoperative consultation, it is important for the physician to set realistic expectations for the patient [16]. Informed consent must be obtained and there should be discussions regarding cost, likely outcomes, limitations of correction, and other issues that may arise when treating a complicated problem like silicone toxicosis [12]. Patients need to be aware that it can be hard to predict results of UAL because there is usually limited information regarding the technique used during the original injections, as well as the amount and composition of the material injected [4, 19]. Photographic documentation is imperative so that any preexisting contour irregularities are noted in the medical record [12]. Most importantly, patients need to understand that it is difficult or impossible to remove all of the foreign material and affected tissue [13, 16, 20]. There is no cure [16]. The realistic goal should be to decrease the patient's pain while optimizing their function and form [16].

Imaging

Preoperative CT imaging of the abdomen and pelvis is used to evaluate the severity of the toxicosis and the depth of silicone deposits [7, 16]. Imaging studies are obtained with the patient in a prone position in order to avoid pressure on the gluteal region [16]. On CT silicone collections can be well-circumscribed or diffuse areas and will appear hyper-dense with occasional accompanying calcifications (Fig. 11.5) [10, 14, 16]. The goal of the study is to determine the level at which the silicone was injected [10]. Although most silicone is placed in the subcutaneous plane, any intramuscular silicone should be noted as it will not be amenable to removal with UAS due to concern for excessive bleeding [7, 16].

MRI, though more expensive, has been shown to be the more ideal imaging modality for patients with liquid silicone injections [7, 8, 10]. MRI shows silicone as heterogeneous in intensity on T1-wieghted imaging and variable intensity on T2-weighted images [14, 16]. The silicone can appear as individual nodules or in a confluent pattern that appears mass-like, suggestive of a connective tissue or infectious process [10, 17]. There is typically a wide distribution of silicone droplets with

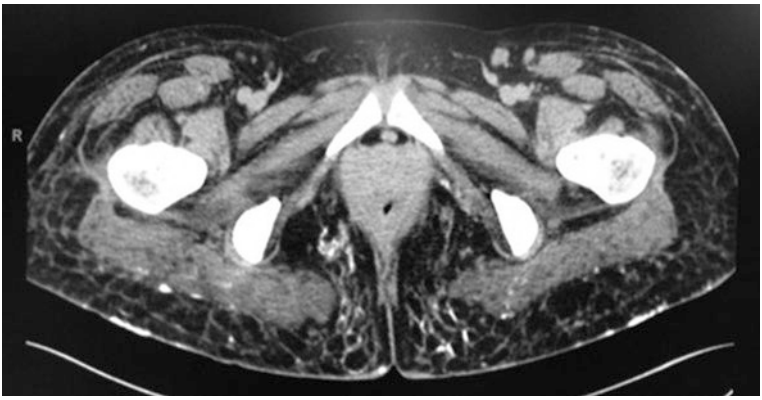

Fig. 11.5 Axial view of the pelvis as seen on CT illustrating Stage III silicone toxicosis. Diffuse hyper-dense areas representing silicone spheres can be seen throughout the subcuticular tissue in the gluteal region with occasional accompanying calcifications

migration of the particles outside of the original injection location through the subcutaneous fat and perineal region. MRI can be useful in demarcating the zone of silicone migration, thus limiting the extent of the surgery while decreasing the risk of symptom recurrence [6].

Although advanced imaging is an essential part of the preoperative planning process, it is important to note the it is impossible to determine the identity of the foreign body material based on imaging alone [10]. Silicone may look similar to other types of permanent fillers, or even fat injections, depending on the imaging study, and a tissue sample is the only definitive way to determine the content of the material [10]. Additionally, it is important to note that large volume silicone injections can obscure the ability to see other pathology on imaging studies, and concern for malignancy or other process should prompt additional workup [8].

Surgical Technique

SAL for Harvesting of Autologous Fat for Grafting

All preoperative topographical markings are made with the patient standing to allow for identification of the natural drape of the gluteal tissue [16]. A circumferential awake standing prep with chlorhexidine solution is completed prior to induction of general anesthesia [7]. The patient is then placed supine or lateral decubitus position on beanbag for SAL of the anterior abdominal, flank, or saddlebag region [7]. Liposuction is performed in the standard fashion until sufficient material for gluteal recontouring has been obtained [7]. One milliliter tumescent solution (1 L 0.9% normal saline with 1 ampule of epinephrine 1:1000) is used for each 1 ml of fat to

be harvested [16]. Aspirate is collected into sterile canisters and prepared using gravity filtration. The fat is then filtered and decanted with a minimal manipulation technique [7].

UAL for Removal of Siliconomas

The patient is then repositioned to prone on the beanbag in preparation for UAL of the gluteal silicone toxicosis and subsequent intramuscular fat transfer. Four millimeter skin incisions for port sites are made within the gluteal cleft and along the inferior-lateral gluteal fold [7]. These sites are then protected using the cut end of a 5 ml syringe at each port site and are secured in place with a 2-0 silk sutures (Fig. 11.6) [16]. Using caution not to burn the skin at the port site, UAL is carried out using a super-wet technique, typically instilling 500 ml of tumescence per side in target areas via a 10in blunt tumescent infiltration cannula [7, 16, 21]. After 15 min have elapsed to allow for adequate infiltration of tumescent solution, UAL is performed with #4 and #5 Mercedes tip liposuction cannulas, to aspirate silicone granules in a plane superficial to the gluteus maximus muscle and deep to the

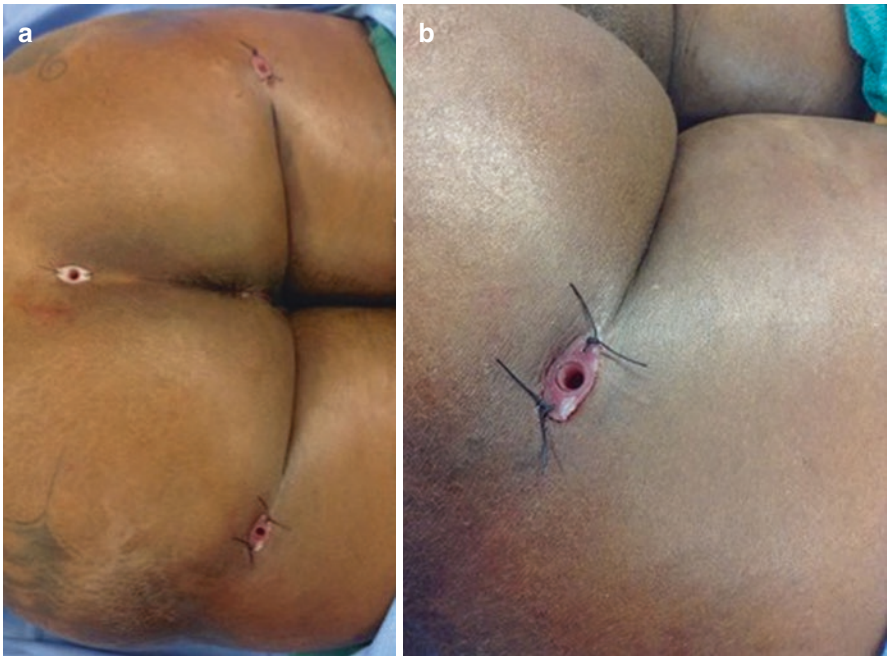

Fig. 11.6 (**a**) PA and (**b**) lateral views of the 4 mm gluteal skin incisions used for UAL port sites within the gluteal cleft and along the inferior-lateral gluteal fold. Sites are protected using the cut end of a 5 ml syringe and are secured in place with a 2-0 silk sutures

subcuticular skin [7]. Specifically, the physician should target areas identified on the preoperative CT scan, as well as areas of increased density based on intraoperative manual palpation [7, 16]. Though highly patient dependent, an average total of about 950 ml of adipose tissue and liquid silicone can be removed [15]. As stated above, the goal is to decrease, not eliminate the silicone burden [7]. The UAL ports are then removed and the remaining stab incisions are closed in two layers with absorbable sutures and skin glue [7, 16].

Lipofilling of Contour Irregularities

The harvested and prepared fat from the SAL of the abdomen and flanks is injected into the buttocks using a 10in blunt fat-injection cannula. Fat is injected into an intramuscular plane during withdrawal of the cannula using a micro-droplet technique. Only small aliquots of fat are distributed with each pass [7, 16].

Pathology Findings

Tissue samples from the UAL should be analyzed by pathology to determine the contents of the aspirate. In most cases, pathology will reveal cystic spaces of varying sizes with surrounding inflammatory infiltrates of lymphocytes, foamy histiocytes, and foreign body giant cells [15]. Histiocytes and giant cells may contain cytoplasmic vacuoles with a pattern like Swiss cheese that is unique to soft tissue augmentation with oils such as silicone, paraffin, or petroleum jelly [6]. Staining of these samples is negative and there is no birefringence in polarized light [3]. These characteristic histologic patterns remain many years after silicone injection and, thus, are a good method to confirm the presence of silicone granulomas [12]. However, these findings do not attest to the purity of the product injected, and since biochemical analysis is typically not performed, physicians are unable to definitively identify material even after surgical removal (Fig. 11.7) [6, 15].

Postoperative Care

Postoperatively, patients are immediately placed in an abdominal binder and compression garment [7]. After 7–10 days, all patients are allowed limited sitting on a doughnut pillow [16]. The doughnut pillow is provided to prevent sitting with direct pressure on the treated region which could lead to necrosis of the injected fat graft [7]. Patients are also instructed to not rest in a prone position for 4 weeks following surgery.

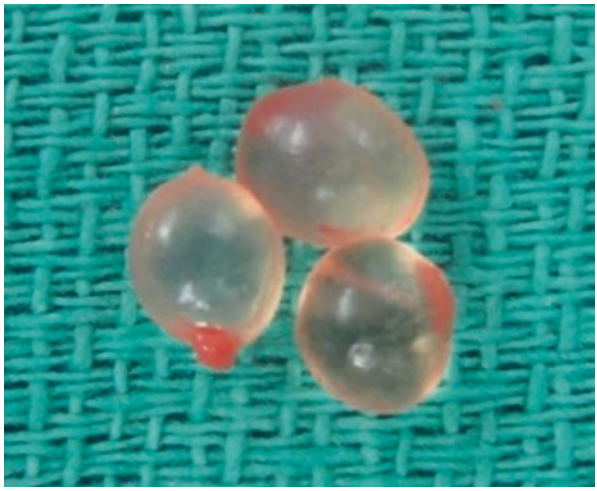

Fig. 11.7 Gelatinous spheres harvested from the gluteal tissues are presumed to be silicone; however, imaging and pathology cannot definitively isolate the identity or the purity of the injected product. Since biochemical analysis is typically not performed, physicians are unable to definitively identify material even after surgical removal

Surgical Complications

Like any surgical procedure, complications can occur in the postoperative setting. Depending on the surgeon's specific formula and technique, tumescence toxicity can occur within the first 18 hours following the procedure [22]. Additionally, SAL can lead to seroma formation even with the appropriate use of abdominal binders and compression garments, and contour deformities can develop if suction lipectomy is performed too aggressively or too superficially. When performing UAL, there is real risk of thermal injury to the skin. Although the use of custom ports to protect the skin is helpful in reducing this risk, they do not completely eliminate the possibility of dermal burns. When re-grafting the harvested fat, there is always a proportion of fat that will not survive long-term and will undergo fat necrosis. Furthermore, high volume injections carry a risk of fat emboli, and respiratory symptoms in the immediate postoperative setting should always be thoroughly investigated.

Outcomes

There is no cure for silicone toxicosis of the gluteal region; however there are techniques that can result in improved quality of life for patients affected by this condition [16]. UAL allows for reduction of the toxin load and limits the inflammatory effects of the foreign body reaction [16]. Combining UAL with SAL and fat grafting is an ideal option for patients with frequent pain and contour deformities who still have concerns over their appearance [16]. Using this technique results in significant improvements in subjective pain and quality of life scores, while avoiding extensive

surgical resections and maintaining favorable aesthetic results [7, 16]. In recent case reports, patients had immediate relief of their pain and softening of the tissues after the procedure and reported improved aesthetic results with reduction in skin thickness and return to normal skin texture [20]. Complete remission was reported by 12 weeks postoperatively, as indicated by complete resolution of cellulitis, elimination of emergency room visits, and avoidance of infections requiring antibiotics [16]. In the event that patients experience some degree of symptom recurrence, it is technically feasible to repeat the treatment more than once in the same area to eliminate any persistent silicone deposits [20]. Although there is no question that the use of industrial liquid silicone is a practice which should be completely contraindicated for aesthetic purposes because of the severe local and distant pathology that invariably occurs, patients deserve to undergo treatment with a goal of balancing improvement in the patient's symptoms with an acceptable long-term cosmetic result [6].

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Chapter 12
Ultrasound-Assisted Liposuction in the Massive Weight Loss Patient

Dennis J. Hurwitz

While initially and still for the most part a standalone procedure, VASERlipo has increasingly become a crucial facet of my excisional body contouring surgery. Advancement flaps are being defatted to evenly reduce size, discontinuously mobilize, and at times harvest fat for lipoaugmentation elsewhere. When VASERlipo is combined with excisional surgery, only a single stage is needed to sculpt an overweight or even obese patient that otherwise would have to undergo VASERlipo either before or after excisional surgery.

Since both the efficacy and safety of combining these procedures remain under scrutiny, combining thorough liposuction with excisional body contouring is not commonplace in my community. The concern has always been that during fat aspiration damage to the connective tissue and or vasculature will result in delayed wound healing. Moreover, large areas of cannula undermining contiguous with advanced flaps could be the source of seroma. Worse yet, there could be devascularization of the skin due to vascular injury leading to skin and fat necrosis and then wound separation vulnerable to cellulitis causing more necrosis and ultimately abscess requiring surgical intervention. Minimizing collateral damage increases the margin of safety.

Lockwood was an early advocate of traditional liposuction of the epigastric flap after it was sutured in place at the end of abdominoplasty [1]. Liposuction preliminary to elevating the epigastric flap was then promoted by Pascal and Le LeLouarn [2]. That procedure was further refined with limited epigastric undermining and called lipoabdominoplasty by Saldanha and other Brazilians [3, 4]. Care is taken to limit undermining to the central 6 cm of the abdomen. This preservation of the lateral perforators limits the inferior dissent of the flap but is sufficient for low closure

D. J. Hurwitz (✉)
Hurwitz Center for Plastic Surgery, Pittsburgh, PA, USA

University of Pittsburgh, Pittsburgh, PA, USA
e-mail: drhurwitz@hurwitzcenter.com

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in most cases. This author prefers to increase the indirect undermining through stretching the tissues along the length of the perforating vessels using a LaRoe dissector (ASSI). Recent clinical reviews confirmed the increased safety of lipoabdominoplasty over conventional abdominoplasty [6]. Within the medial arm and thigh excision sites, radical liposuction has been advanced for retention of neurovasculature while removing skin only [5–7]. Cosmetic liposuction of the surrounding tissues of the arms and thighs can be safely performed in moderation.

Since traditional liposuction indiscriminately avulses of all soft tissues within the course of thrusting a multi-holed cannula, thorough defatting is considered traumatic and too dangerous. Since ultrasound-assisted lipoplasty (UAL) limits most of the damage to fat, UAL better preserves neurovasculature. As such, UAL offers additional safety over traditional liposuction when combined with body contouring surgery.

Two manufacturers simultaneously introduced what became known as second-generation liposuction to American surgeons in the early 1990s. The author joined a task force that plastic surgeon societies formed to teach its safe and effective use. Within a few years the LySonix system, distributed through the Mentor Corporation, became the exclusive technology. Ardent adherents like myself used it throughout the body but are most pleased with its effectiveness in fibrous areas such as the back and epigastrium, in gynecomastia, and in secondary surgery. Nevertheless, the added expense, time, rare seroma, small thermal injury, or neuropraxia deterred most plastic surgeons from adopting UAL. Clearly the fatty emulsion delivered through the in-line suction followed by the liquid in the aspirating cannula supported evidence to the explosive cavitation theory of rupturing fat cells as the source of the energy's unique effectiveness.

Working in my clinical laboratory during the mid-1990s, Bill Cimino, PhD, refined his development of his resonating system of ultrasound delivery by designing a solid probe with multiple rings at the end. He called it VASER, an acronym for vibration application by sound emission resonance. VASER causes cavitation through bubble coalescence of the infused saline leading to disruption of the fat globules. Soon after exposure to the vibrating rod, a vented aspirating cannula called VentX gently removes the dispersed fat, leaving maximum retention of the connective tissue and neurovasculature. While more efficient and less strenuous to the surgeon, follow-up aspiration with a power-assisted lipoplasty (PAL) device disrupts some of the vasculature and connective tissue that has been so carefully preserved. I prefer to use a different PAL system. Sarah Hall PA-C, my physician assistant liposuctioner (PAL), will turn over the aspirating cannula shortly before she's finished in a given region for my final thrusts thereby sparing me considerable time and effort.

After using the VASER for 10 years, my hospital refused to continue paying rental for the machine since we also had the LySonix 3000. Since the latter was effective, I liked the visual feedback from inline suctioning, and I did not understand the difference between the technologies; I used the other ultrasound technology. I performed combined surgery of UAL with excision in massive weight loss patients for 6 years. All operations over 3 hours were admitted to the hospital and

routinely had delay blood loss demonstrated by a 2–4 gram drop in hemoglobin by the next morning. Delayed transfusion was occasionally necessary. This phenomenon of delayed blood loss after LySonix lipoplasty was similarly demonstrated by Swanson [8]. Dramatic fluid shifts were an issue that required close monitoring of vital signs, urine output with frequent adjustments of IV fluid rate. Overall the patients suffered considerable pain and prostration.

It wasn't until the striking pig experiments of absent bloody extravasations performed by Dr. Onelia Garcia and dramatic 3D VASERlipo demonstrations by Alfredo Hoyas that I understood what could be more safely and artistically accomplished with VASERlipo. The time for fat grafting had come so it was opportune that VASERlipo provided a high percentage of harvested fat for lipoaugmentation substantiated by both Michael Longacre and Peter Rubin's laboratories. In all, I was convinced that purchase of this $120,000 technology would lead to not only better and more consistent results but also patient safety.

Proper instruction by experts, presented elsewhere in this textbook, is essential and even more so in combination with excisional surgery. Beginning with isolated VASERlipo cases, I progressed to the combined procedures. It became quite clear that following body contouring surgery with even extensive VASERlipo, the patients did much better. The patients were in less pain and did not feel sick. Vital signs were stable as was the urine output. There was no drop in the hemoglobin obviating blood transfusions. In fact, unless there were medical indication, or the operations were exceptionally long, patients were no longer admitted after complex operations even after a 3- to 4-person team worked up to 4 hours.

Neither I nor other proponents of VASERlipo have the clinical data to substantiate the improved patient tolerance to this modality in both its isolated and complex usage. However, our salutary clinical experience makes it unethical to compare VASERlipo with alternative approaches. We could comprehensively monitor patients for outcomes to substantiate these clinical observations. Alternatively, we could compare VenTx aspiration to power-assisted lipoplasty to unravel whether that vibrating cannula causes clinically significant trauma over hand strokes.

Until studies of the postoperative condition have been performed, the reader will have to rely on our observation and impressions. At least there are no published studies that contradict our observations. Regarding delayed blood loss, clearly, second-generation ultrasonic technology does not compare to the VASER. My own unpublished experience with LySonix UAL confirms his observations which again should not be extrapolated to the third-generation technology. Due to poor sales, Mentor Corporation recently stopped distributing LySonix 3000, while Solta is enjoying increasing sales of VASER.

In principle, VASERlipo with excisional body contouring offers two clinical possibilities. One is that the excision can be limited, which reduces surgical trauma and scar burden. Two is that VASERlipo complements major excisional surgery which thins the patient, mobilized flaps, and lent broad impact across the entire body in a single stage.

With limited surgery, the first case is a common example. In anticipation of her first marriage, a 43-year-old realtor requests a breast lift, so she would be confident

enough to expose her sagging breasts to her fiancé. She not only was embarrassed by her old ladylike sagging breasts, but the areolas were far too large. She has scoliosis with her right mid torso larger than the left. She agreed that contour improvements upper torso would be desirable, but she wanted to limit surgical scars. The lower abdominal skin laxity as well as suprapubic transverse contour depression made a limited abdominoplasty leaving a low-lying, under-panties scar essential. We agreed to VASERlipo in her back, flanks, and epigastrium. This 5′5″, 148-pound, BMI 24.6, woman also agreed to process her harvested fat for lipoaugmentation of the smaller right breast with insufficient superior pole, and both depressed lateral gluteal regions. She underwent a 3½-hour team operation with an experienced University of Pittsburgh senior resident, my physician assistant, and my additional surgical assistant in the Waterfront Surgery Center, Homestead, Pennsylvania.

Her preoperative markings indicate the circumvertical mastopexy, limited abdominoplasty, and torso areas for VASERlipo (Fig. 12.1). The magnitude of anticipated liposuction is indicated from 1+ to 3+. Lipoaugmentation is indicated in green minuses. The Mick Jagger Lips limited abdominoplasty is designed to maximize lateral skin tension at closure with the least pull between the umbilicus and mons pubis.

The operation begins prone with a roller pump diffuse infiltration of 4200 cc of saline from 3 liter bags that have 60 mL of 1% Xylocaine, 5 amps of epinephrine, and 1 g of cephalosporin. Infusions were 800 mL for the right back, 700 ml in the left back, 600 mL in the right flank 1050 left flank, and 500 mL in the sacrum, later 700 cc in the abdomen. Through strategically placed 1 cm incisions, plastic skin protectors were inserted followed by two ring probes at 80% VASER power. VASER times on the back were 3–4 minutes in each area except for 7 minutes over the sacrum and later 9 minutes over the sacrum. Loss of resistance was our main guideline.

Through a 3.7 mm VentX cannula which has four openings near the tip, 2600 ml of fatty emulsion was collected in a sterile glass cylinder. Each side of the upper back has 300 mL aspirated and 400 ccs from right flank and 500 mL from the left flank and the sacrum and 700 ml from the abdomen. From a total of 2700 mL fatty emulsion, 700 ml of fluid was decanted. The remaining emulsion was poured through a kitchen colander and from this blood-free 600 ml of usable fat was isolated. That was then scooped into 10 cc syringes and then injected through 2 mm blunt-tipped Coleman side-hole cannulas for 260 mL on the left lateral buttocks and 160 cc on the right buttock. Later when she was turned supine, 140 mL of fat was injected into the superior pole of the right breast.

While the lipoaspirate was collected by my assistants, superior pedicle circumvertical mastopexy was performed. The superior pedicle includes the central inferior pole of breast. The distal end was sutured up under the breasts to the pectoralis muscle at the second rib, looking like a scorpion's tail. This auto augmentation central pedicles were supported with 4 × 6 inch strips of GalaFlex slings, a monofilament mesh of Poly-4-hydroxybuterate. The sling was suture to the underlying

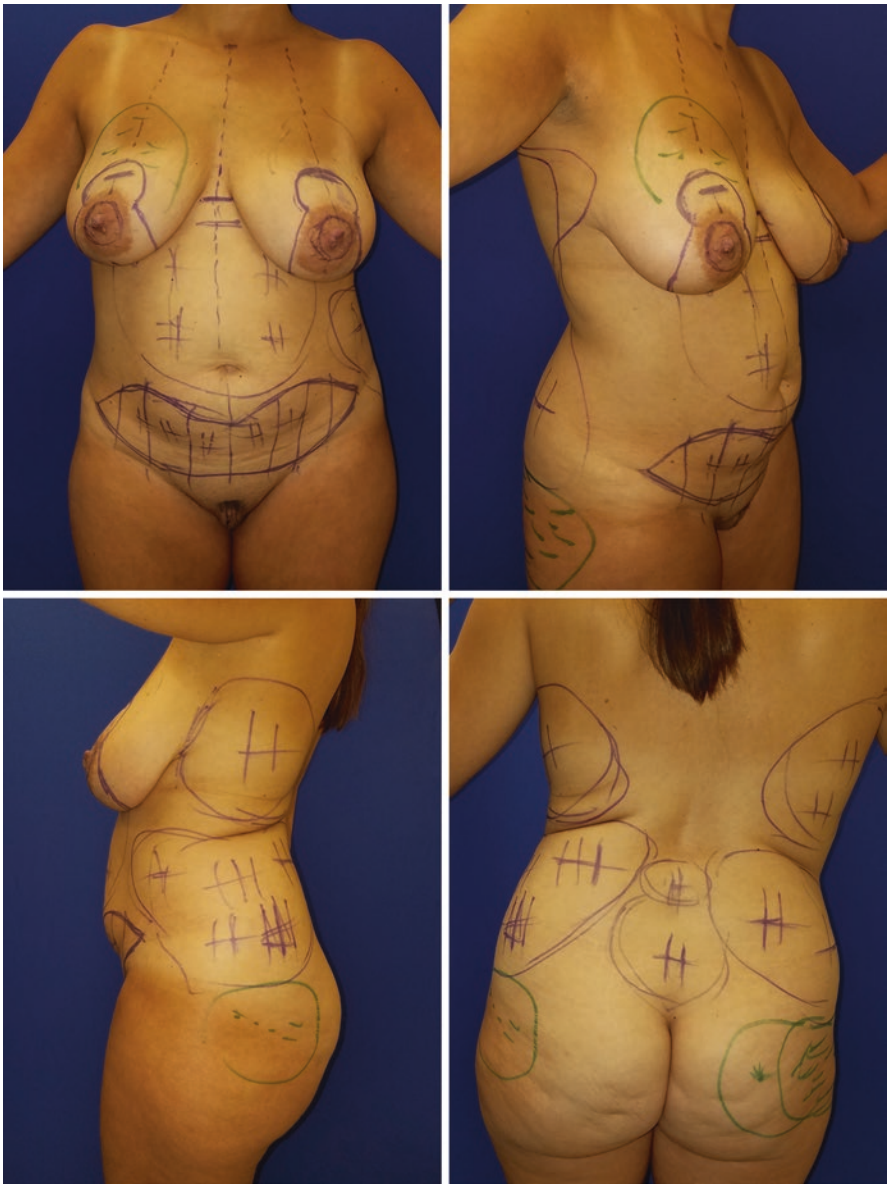


Fig. 12.1 Case 1 preoperative markings indicate the circumvertical mastopexy, limited abdominoplasty, and torso areas for VASERlipo. The magnitude of anticipated liposuction is indicated from 1+ to 3+. Lipoaugmentation is indicated in green minuses. The limited abdominoplasty is designed to maximize lateral skin tension at closure with the least pull between the umbilicus and mons pubis

pectoralis muscle and then curled around the rolled central pedicle to be sutured to the 3, 6, and 9 o'clock positions on the areola, thereby securing the position of the imbricated central flap and restricting areola stretch. Then the lateral pillars were sutured under the raise central pedicle and the circumvertical closure with 3-0 PDO Quill.

The abdominoplasty was simply a cutout of the preplanned lower abdominal incisions, followed by minimal direct undermining to the level of the umbilicus along with VASERlipo indirect undermining of the epigastrium and then closure with #1 PDO Quill and 3-0 intradermal Monoderm over laterally placed JP drains.

At 10 months the anticipated results were obtained (Fig. 12.2). The breasts remain raised, rounded, and nearly identical in size. The superior poles remain full and the areolas small and at the most projecting aspect of the breasts. Her left lateral view shows an ideal 40–60 ratios of upper to lower pole fullness. She prefers the slight redundancy of skin at the IMF over an excisional scar. All torso contours are improved with no skin laxity. She went from rectangular figure to nearly an hourglass with her waist narrower and the buttocks rounder. Her waist-to-hip ratio changing from .90 to a more desirable .74. Soon to be married, she is now pleased with her unclothed appearance.

While the first case of VASERlipo dominated throughout the body contouring, this second case shows its impact on the upper body while the lower body undergoes extensive revision excisional surgery. This 35-year-old male was dissatisfied with his gynecomastia and his lower torso extended abdominoplasty with three flank liposuction sessions 14 years previously after losing 50 pounds (Figs. 12.3, *upper*, and 12.4, *upper*). An oblique flankplasty was combined with a lipoabdominoplasty to solve the lower body skin and adipose redundancy [10]. The gynecomastia and upper body laxity was treated by VASERlipo followed by application of bipolar radiofrequency energy (BodyTite by InMode, Tel Aviv, Israel). His markings plan VASERlipo followed by BodyTite for the anterolateral chest and a lipoabdominoplasty with posterolateral extensions of oblique flankplasty that includes most of his extended abdominoplasty scars.

The operation begins prone with 700 ml of saline with Xylocaine and epinephrine infiltrated into each lateral chest. Three minutes of continuous single ring probe VASER energy, followed by 150 ml of fatty emulsion. Then bipolar radiofrequency was applied for 10 kilojoules each side. While the physician assistant was performing those tedious treatments, the resident and I and my surgical tech performed the oblique flankplasties. He was then turned supine for simultaneous treatment of the chest with the lipoabdominoplasty. Through VASERlipo, midline undermining, and LaRoe dissection, the prior incomplete limited abdominoplasty could be converted to a complete abdominoplasty. Meanwhile I applied VASERlipo and then BodyTite to the gynecomastia and anterior chest. Infiltrated into each breast was 700 ml of saline with Xylocaine and epinephrine. After 3 minutes of VASER, 150 ml was extracted through 3.7 mm VentX cannulas from each chest. Then BodyTite was applied for 11 minutes to the chest (see RFAL video). An hour later the lipoabdominoplasty was completed.

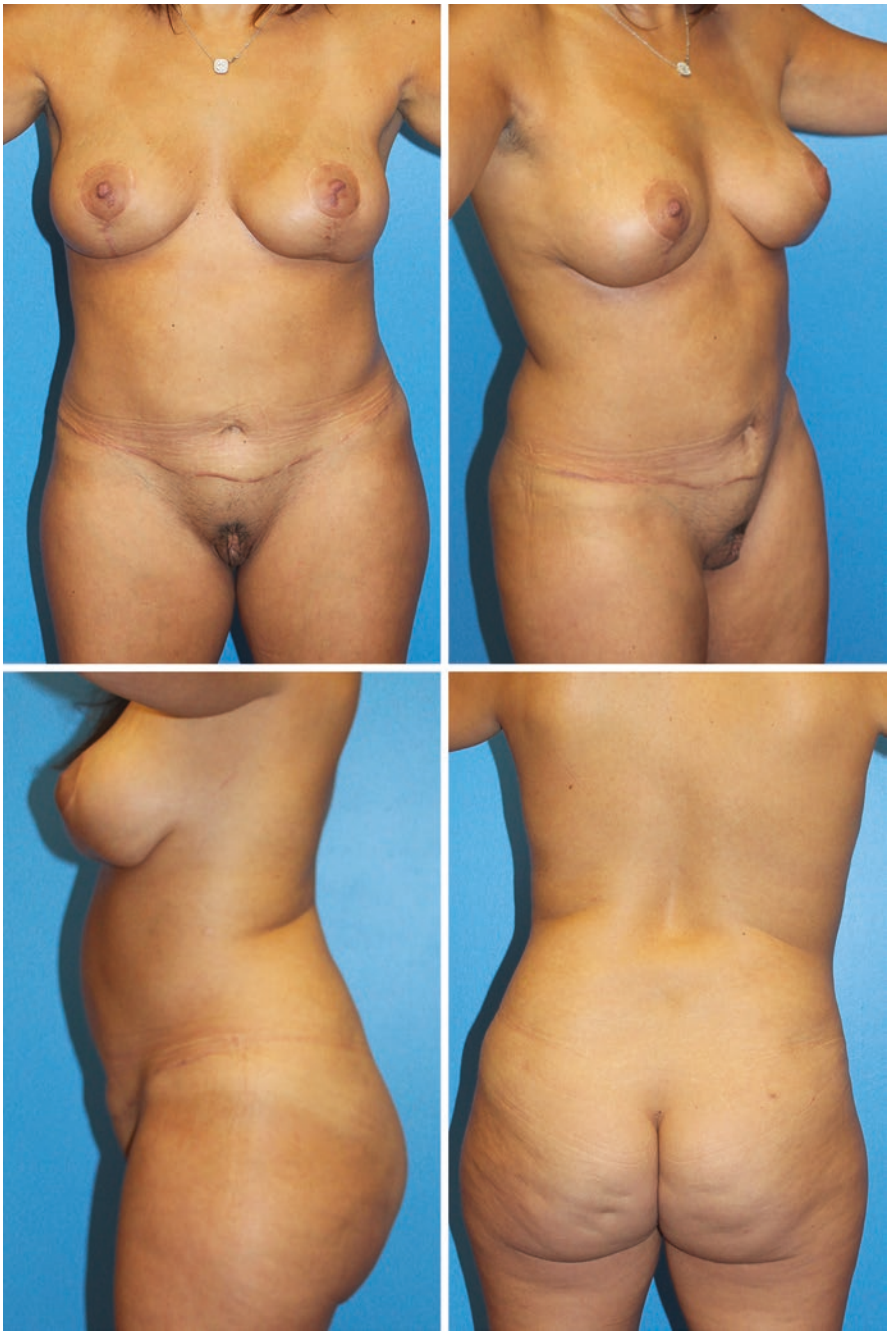
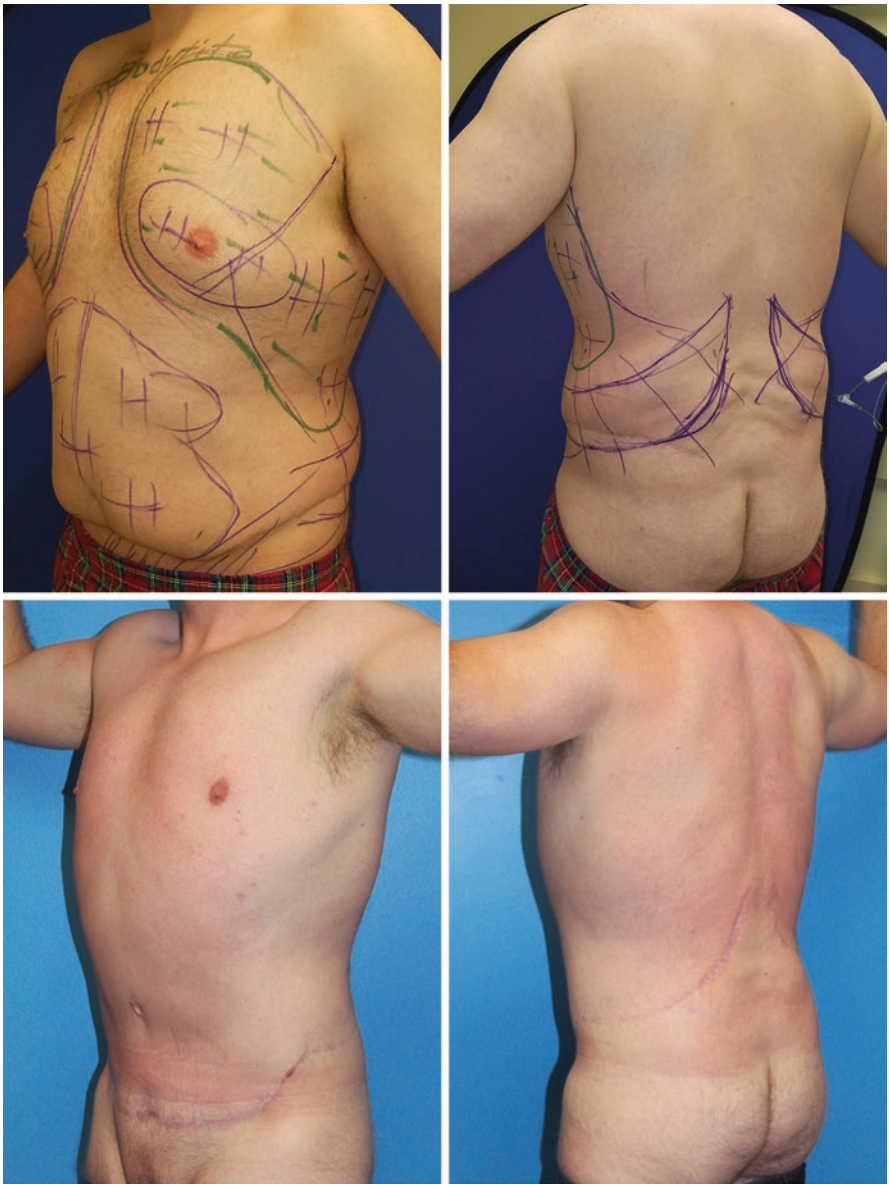
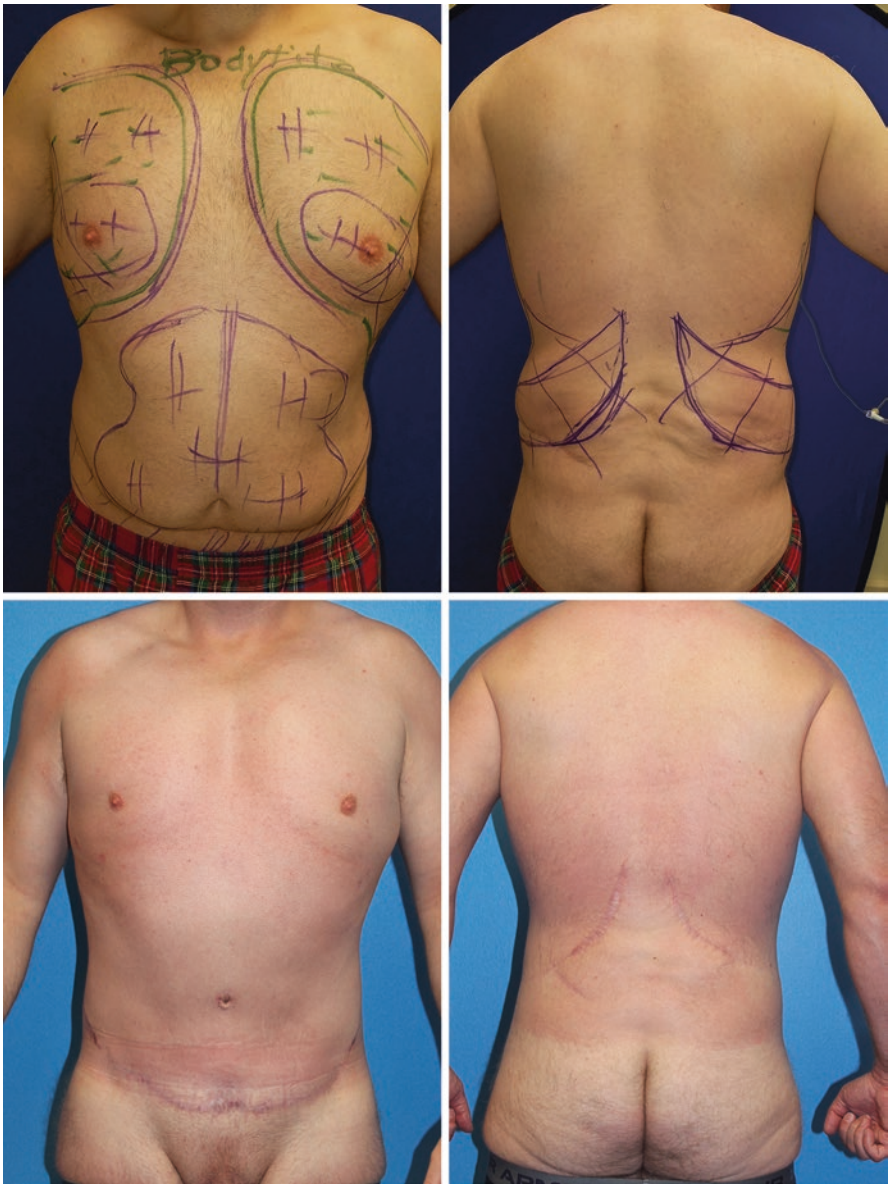


Fig. 12.2 Case 1 at 10 months, the breasts remain raised, rounded, and symmetrical. Her left lateral view shows an ideal 40–60 ratios of upper to lower pole fullness. All torso contours are improved with no skin laxity. She went from rectangular figure to nearly an hourglass with her waist narrower and the buttocks rounder. Her waist-to-hip ratio changing from .90 to .74



Figs. 12.3 and 12.4 Upper. Case 2. 35-year-old male was dissatisfied with his gynecomastia and his prior extended abdominoplasty with multiple flank liposuctions. An oblique flankplasty was combined with a lipoabdominoplasty to solve the lower body skin and adipose redundancy. The gynecomastia and upper body laxity was treated by VASERlipo followed by application of bipolar radiofrequency energy BodyTite. His markings plan VASERlipo followed by BodyTite for the anterolateral chest and a lipoabdominoplasty with posterolateral extensions of oblique flankplasty. Lower. Case 2. The result 14 months later shows smooth and tight-skin torso that reveals underlying muscularity and upper body dominance with minimal scars



Figs. 12.3 and 12.4 (continued)

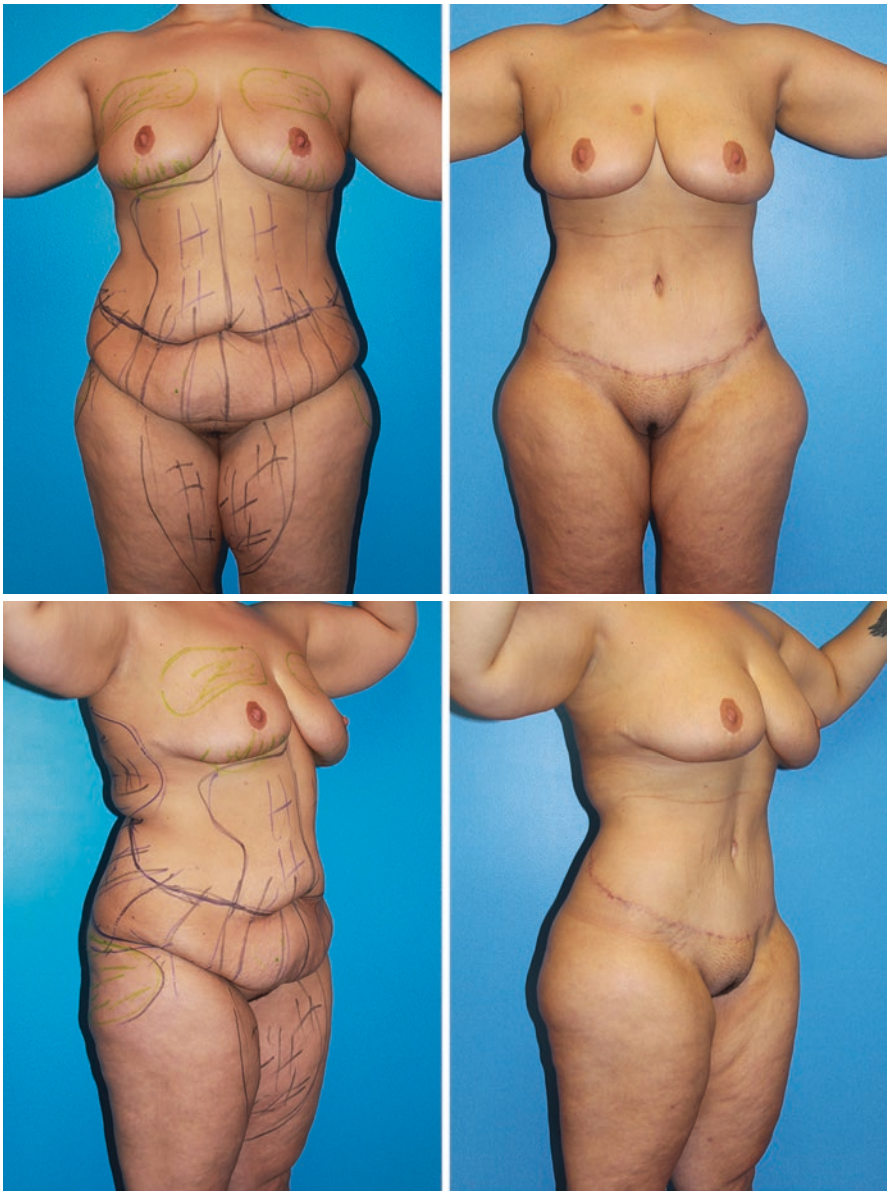
The result 14 months later shows the completed surgical transformation followed by revitalized muscle building workout routine. He has a smooth and tight skin torso that reveals underlying muscularity and upper body dominance with minimal scars (Figs. 12.3 and 12.4 *lower*).

The third case demonstrates the interplay of VASERlipo throughout major excisional body contouring surgery. This 27-year-old woman lost 100 pounds but despite the best efforts of her nutritionist, she was stuck at 31 BMI. She accepts being full bodied but wants to get rid of loose skin and unaesthetic adipose bulges. She desires a narrow-waisted, sensuous figure, which includes enlargement of her previously reduced breasts and lateral buttocks. Her preoperative markings indicate the proximity of VASERlipo areas to excision sites (Figs. 12.5, 12.6, 12.7, 12.8, and 12.9*, left*). Since she desired lipoaugmentation, VASERlipo was on VASER mode and reduced power. The emulsion was collected in a sterile cannister and reconstituted as before.

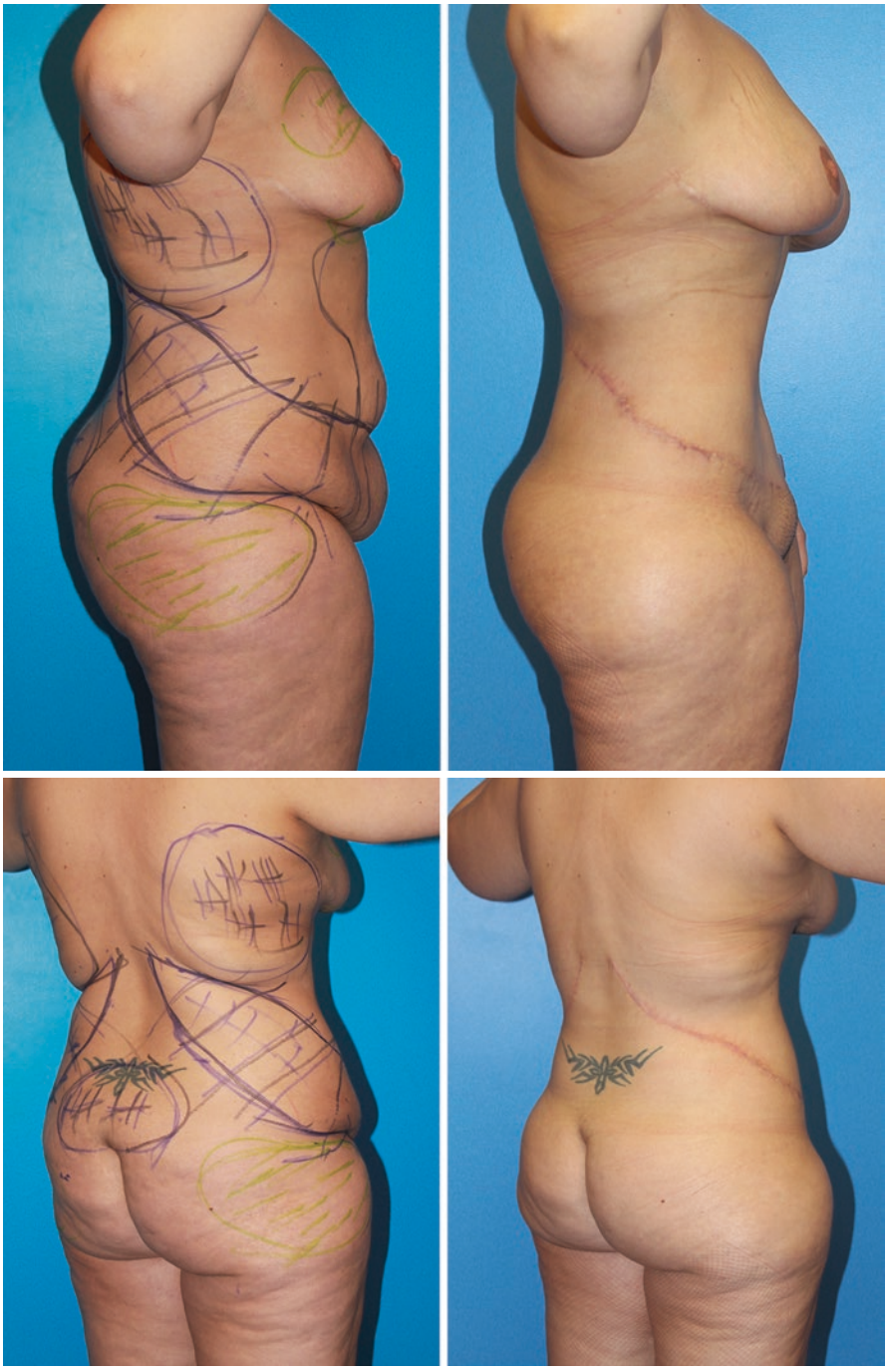
Plastic surgeon Bertrand LaCotte of Plastic Surgery Videopedia sent retired renowned Houston plastic surgeon and educator Tom Biggs, MD, to my operating room to video this case. The video demonstrates that complex management of adipose is essential to advanced patient sculpturing. Planning starts with the patient enunciating her body issues and what they desired to be accomplished. Obviously, I coach them to be observant and critical and asked them to what lengths they wish to go through to have the most desirable figure. Pertinent anatomy considers musculoskeletal form with fat distribution modifying our approach and expectations. If they are endomorph, they will still be an endomorph and cannot be transposed into an ectomorph. A curvaceous full-bodied torso is a desirable exchange from a rectangular-shaped figure with hanging loose roles of skin. A high BMI over 30 does not disqualify a patient from this complex surgery if the fat is primarily in the subcutaneous plane.

Her video is segmented into three parts with commentary here that summarizes each part. Part 1 is the drawing of the operative plan on the patient. Lipoabdominoplasty is planned with lateral incisions that widely stride the anterior superior iliac spine. The oblique flankplasty [9] excisions are centered over the bulging flanks. With removal of the oblique band of tight adherences [11], the loose skin is suctioned over the scapula and across the sacrum and then pulled tight upon closure of the flank excision. In other words, upon release of the oblique flank adherences, each side of the entire back can be sculpted through VASERlipo. The amount of the width of the flank excision is determined after forceful upward pushing of the lateral buttocks while tissue gathering of the excess flank skin.

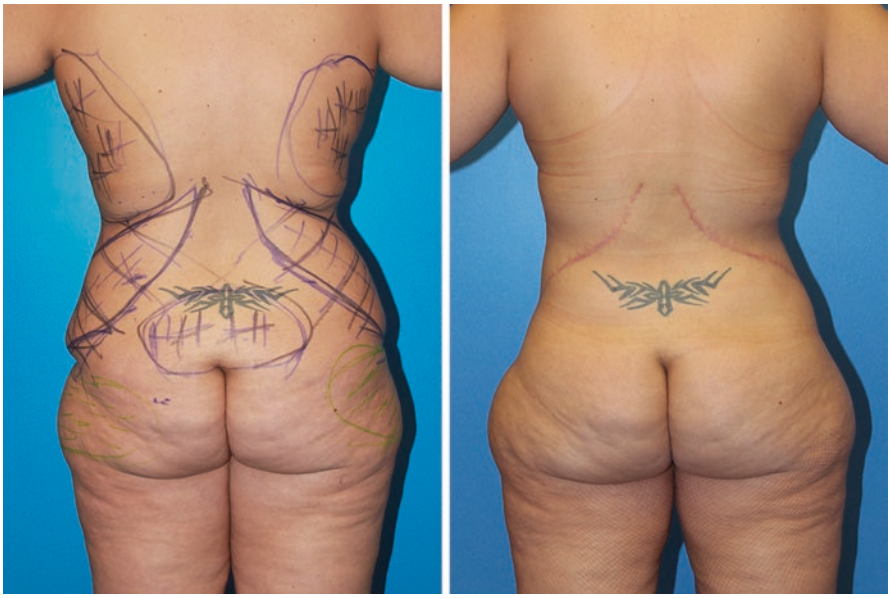
Part 2 is the operation in the prone position. To harvest adequate fat for buttock lipoaugmentation, VASERlipo starts within the flank excision sites, which are then excised while VASERlipo is performed elsewhere. Team surgery is a critical aspect of being able to perform these operations efficiently and safely. As such I've been able to do most of them under 4 hours and discharge the patients in every case from the ambulatory surgery center under a closely monitored situation. My surgical team consists of me as the lead and coordinating surgeon and my technically able physician assistant, my office surgical technician, and one of the senior residents from the University of Pittsburgh plastic surgery residency. As visualized, for the most part, two to three procedures are being performed simultaneously and under



Figs. 12.5, 12.6, 12.7, 12.8, and 12.9 Left, before, and right, 5 months after. Left. This 27-year-old woman lost 100 pounds but was stuck at 31 BMI. She wants to get rid of loose skin and unaesthetic adipose bulges. She desires a narrow-waisted, sensuous figure, which includes enlargement of her previously reduced breasts and lateral buttocks. Her preoperative markings indicate close proximity of VASERlipo areas to excision sites. Right. At 5 months she is pleased with her tight skin and sensuous shape as the scars are fading



Figs. 12.5, 12.6, 12.7, 12.8, and 12.9 (continued)



Figs. 12.5, 12.6, 12.7, 12.8, and 12.9 (continued)

my direction. Concurrent VASERlipo can be disruptive even if it's being performed at some distance from the operative site. Patient is shaking, suction tubing and cannulas may be on the way. My energetic assistant may be elbowing her way into my field or I may have to position myself awkwardly around someone to accomplish the operation. All the while I have to keep an eye on what is being accomplished elsewhere and to intervene as necessary. All this activity leads to an incredibly stimulating and engrossing experience that is both challenging and captivating. All my patients are advised as to the importance of team surgery and must consent my plan of action. For the rare objection to team surgery, the patient must accept less being accomplished during a given operative session. One of the advantages of this videotape is to see this process in action. The epigastric redundancy is advance posteriorly as the flankplasty excision site is closed. As my assistants are completing the closure, I am injecting with syringe into the lateral buttocks fat processed from the sterile cannister by one of my medical techs.

Part 3 is the operation with the patient turned to supine. VASERlipo of the epigastrium is followed by the superior incision. I favor VASERlipo and then undermining of the epigastric flap first, because I want it fully prepared to cover the lower abdomen as soon as the excision between the umbilicus and mons pubis is completed. That limits time exposure of the denuded lower abdomen with possible contamination and excess loss of body heat to a minimum. That aspirated epigastric fat and harvest from the medial thighs will be used to lipoaugment poorly projecting breasts due to prior reduction. The midline is undermined to the xiphoid. Prior liposuction and stretching with the LaRoe dissector completes the indirect undermining.

The table is deeply flexed with no concern for the flankplasty closure, so the abdominal skin is tightly stretched down and across the entire abdomen. She then demonstrates her 5-month result. Pleased with her new look, she has scheduled VASERlipo of the arms (Figs. 12.5, 12.6, 12.7, 12.8, and 12.9, *right*).

Since the purchase of my own VASER 4 years ago, we have performed over 120 cases each year with roughly half combined with excisional body contouring. The few cases electively admitted to the hospital were because of operative times anticipated over 4 hours or increased anesthetic or medical risks. Over the past 3 years at the Waterfront Surgery Center, I've had only two body contouring patients that required hospital admission for medical care. One had closely controlled nephrotic syndrome that developed fluid imbalance requiring in-hospital management and dialysis leading to rapid recovery. The other suffered a vasovagal response requiring hospitalization and a unit of blood transfusion. None of the over 300 patients were transferred for in-hospital care.

Selectivity for fat extraction provides VASERlipo an advantage over competing technologies [11]. Waterjet and vibration lipoplasty are purported to have similar selectivity and safety margins but I have no experience. I am comfortable with the added time for the VASER step, knowing that the operative trauma and blood loss is far less than with traditional liposuction and the results are close to expectations with rare contour disappointment.

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Chapter 13
High-Definition Body Contouring Using VASER-Assisted Liposuction

Alfredo E. Hoyos and David E. Guarin

Introduction

The body's natural envelope is a complex system which includes the superficial skin and a complex fat layer. The fat complex organization includes several variations in cellular density, thickness, metabolic activity, function, sensibility to lipolysis and many other features which are the outcome of an exquisite genetic transduction and the individual behavior. The heterogeneity of this disposition creates different types of bodies. Aiming to facilitate, the diagnosis and classification have been gathered into three main groups or biotypes according to their general external shape: mesomorph, ectomorph, and endomorph. A mesomorph has good muscular development and an athletic appearance; the ectomorph has thin, long, tall looking body, and the endomorph body easily accumulates fatty tissue especially in the lower body [1].

The ideal biotype has to be analyzed according to age and gender. For males, it has been fairly constant: From ancient Greek and Roman times, the renaissance and even the contemporary movements share the same concept about the ideal male body which is athletic with a well-defined muscle bulk mass which indicates youth, vitality, and health. For women, the ideal biotype is a concept that constantly changes throughout history. It is influenced by fashion trends, age, ethnicity, health issues, and tendencies. Just by looking to the last century, these changes were evident: After the World War II, with the return to a wealthier lifestyle, the curvy, hourglass shape was the ideal, giving special importance to the breast size and little attention to the waist; In the 1960s the woman's liberation movement changed

A. E. Hoyos (✉)
Private Practice, Bogotá, Colombia

Clinica Dhara, Department of Plastic Surgery, Bogotá, Colombia

D. E. Guarin
Universidad del Valle, Hospital Universitario del Valle, Department of Plastic Surgery, Cali, Valle del Cauca, Colombia

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everything: women start to take part in the social and political life, the miniskirt was the official trend, and the curvy woman was not the ideal anymore, leading to a thinner body with long-looking limbs. In the 1970s, the hippie trends take place; the informal female appearance was the rule. The 1980s was the time of the supermodel: a sexy, curvy, and pretty woman can be rich, famous, and successful just because of the way she looks. Women everywhere find this as the ideal and start to look forward to look like them. The 1990s' ideal was "the thinner the better" up to an unhealthy serious concern and an anorexia epidemic started to blossom. The 2000s was a response to the 1990s leading to a change in mentality toward a healthier image [2] (Fig. 13.1a, b).

Nowadays, there is no single leading trend; the particular desires have to be addressed based on the individual aspects as the geographic location, age, fashion trends, and ethnicity.

Surgical improvement of the human shape was greatly enhanced with the development of the liposuction techniques. The first attempts to do so only removed the extra fat tissue to create a flat contour. As the quality of the procedures improved the patient's expectations began to grow, asking for better and more natural outcomes. The natural ideals comprise a complex mixture of shapes consisting in concavities and convexities which translate the underling muscles and bones to the superficial envelope and create the desired contour. By contouring with a selective extraction of some places and grafting the fat tissue on others, better outcomes can be achieved and the desired athletic body can be reached. This method lets us individualize the needs of each patient to offer a tailored option according to each body biotype [3] (Fig. 13.2a–c).

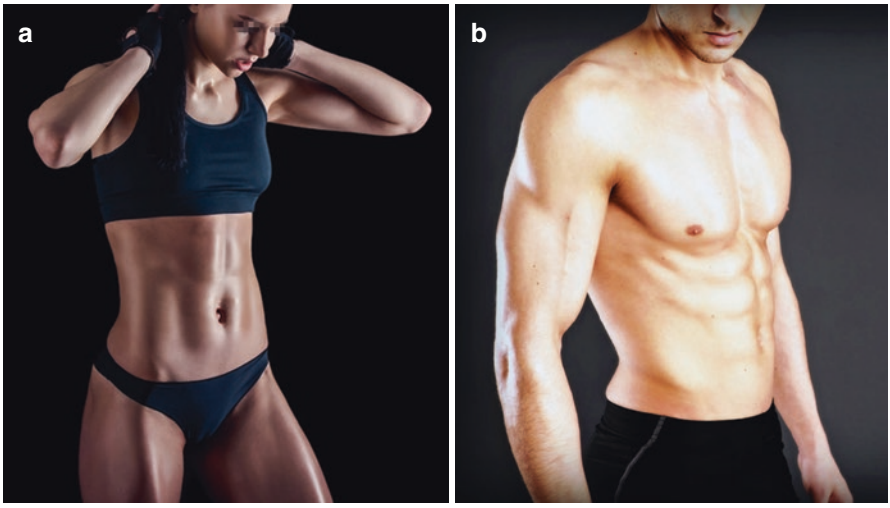

Fig. 13.1 (**a**) Healthy fit female. (**b**) Healthy male

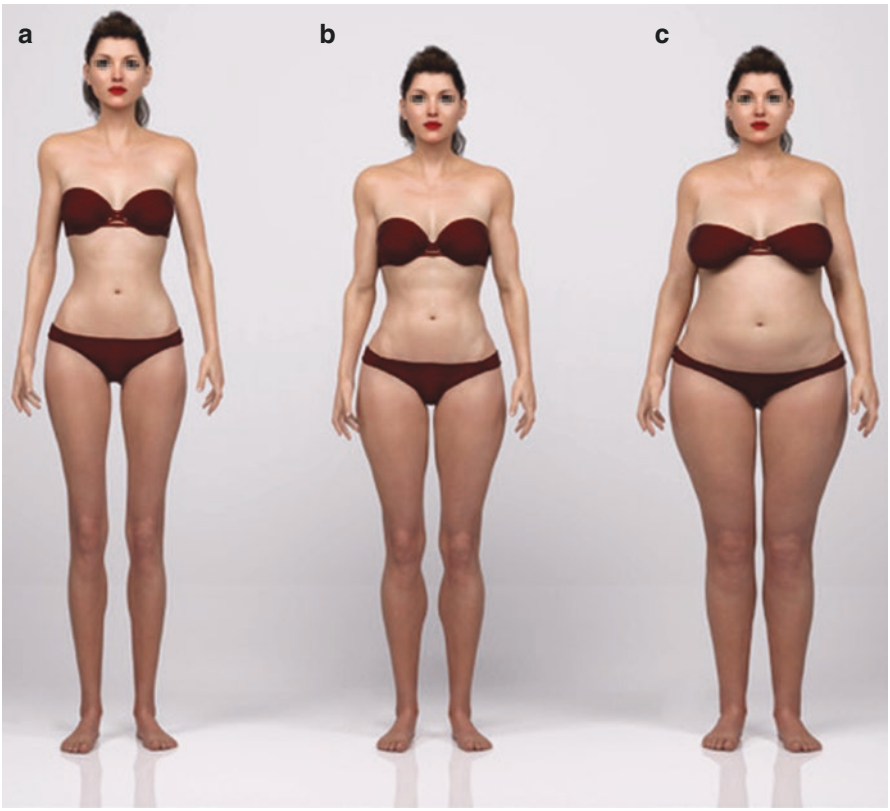

Fig. 13.2 Body biotypes: (**a**) Slim/ectomorphic. (**b**) Athletic/mesomorphic. (**c**) Fat/endomorphic. Each biotype requires a different approach to achieve the best results

The Ultrasound

The improvement of the ultrasound technologies to assist the liposuction overcomes the limitations and serious complications of the first ultrasound generations. The pulsed low-power ultrasound with a solid small-diameter titanium grooved-tip probe increased the efficiency of fragmentation of the fat tissue mainly by means of cavitation. The secondary thermal effect also had an effect on the underling dermis allowing to improved retraction of the skin.

Becoming a safer procedure with a better control of most complications leads to extraction of higher amounts of fat and facilitate the secondary procedures. As the learning curve improves, the replicability of the results enhances.

The marking process is an essential part of the procedure. The superficial anatomy must be considered as a dynamic structure that must be tailored to each patient's condition, anatomic landmarks, and muscular movements. This approach implies an

Fig. 13.3 Sample of the alpha muscles: The deltoid is not the biggest muscle of the arm, but it is the one that gives the impression of power and health and contributes to the V shape of the torso

extra effort in preparation and the anatomical and artistic knowledge about body aesthetics to identify the dominant or "alpha" muscle from each anatomical area. The alpha muscles are responsible for defining the body shape in every region of the anatomy; it may be not the bigger muscle but the one that gives the "identity" of an athletic shape as seen in Fig. 13.3 [4, 5].

The adequate warping of the skin after the fat removal is a pivotal issue to be considered to reach the desired outcome. This is an intrinsic characteristic of the skin that is related mainly to age, nutritional factors sun exposure, body type, and weight changes. For this reason, each patient must be individualized and analyzed to get the best possible result. The retraction has to be considered in a three-dimensional way: horizontal, vertical, and depth level. Better results are achieved when the sculpturing is done in a circumferential manner (Fig. 13.4).

Complications

The complications derived from the liposculpture and the ultrasound must be prevented and carefully addressed for patient safety and the success of the procedure.

The seromas are the most frequent complications caused by the mechanical disrupting of the lymphatics and the trauma to the soft tissue. The systematic use of drainages on selective areas like sacral in women and inguinal in men easily reduces the presence of seroma.

Coloration changes are a common issue due to the trauma in the vascular subdermal plexus resulting in the cutis marmorata. This can be addressed using smaller 3 mm cannula for superficial use in some areas: waistline, inner thighs, posterior arm, and neck.

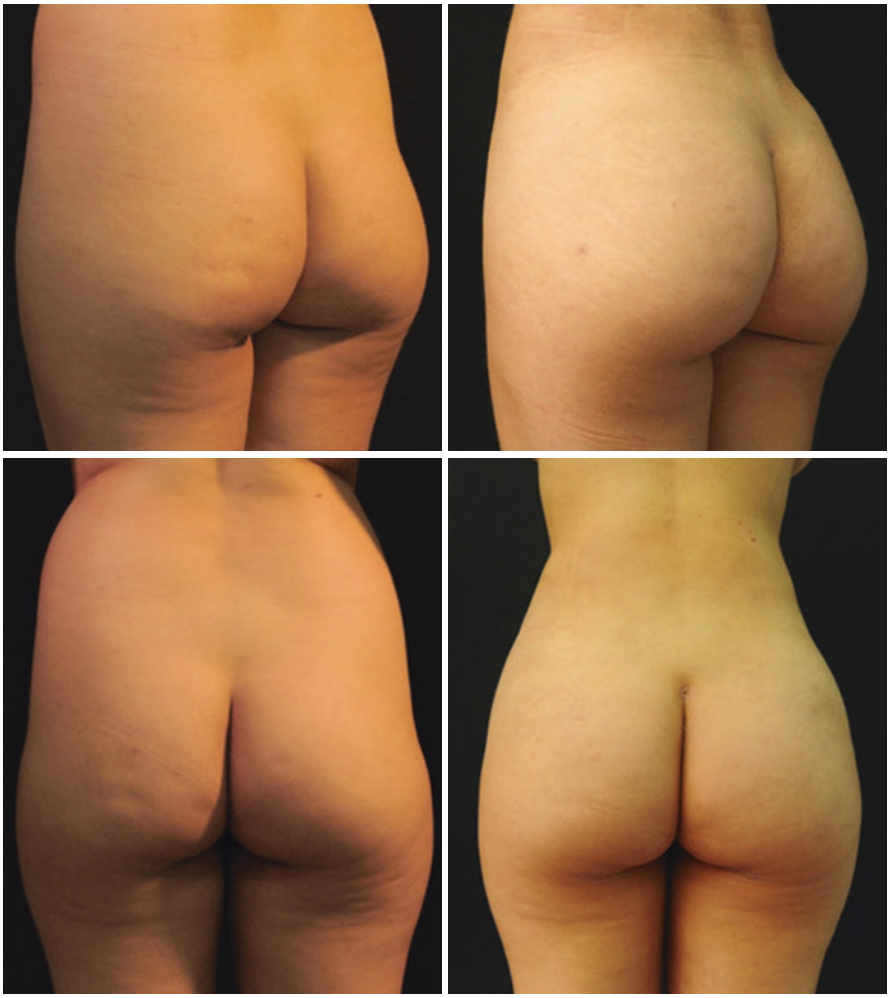

Fig. 13.4 (**a**) Pre surgical images. There is a lack volume the medial ans superior gluteal area, poor definition on the lowerback and a trochanteric depression. (**b**) Post surgical images. There can be seen a smooth transition from the waist, hips and the upper tigh and an aquedate superior volume

The burns are closely related to the learning curve. Virtually all of them can be prevented by systematically protecting the skin with an adequate infiltration, wet surgical towels, and tightly secured ports.

As the skin flap is thinned searching for retraction, irregularities on the contour derived from wrinkling and irregular draping can occur. To properly drape and avoid this issue, the use of a foam compression garment enhances and makes even the pressure reducing the irregularities and enhancing the recovery time [2].

The Contouring Process

Preparation

The fat extraction must be done in a multilayer and anatomical basis aiming to reproduce the superficial muscular anatomy. Fat grafting is an essential part of the contouring enhancement to achieve a realistic athletic shape. The muscular definition process can be easily done by means of extraction, grafting, and a good skin retraction. Special attention must be taken over specific "alpha" muscular groups: the rectus abdominis, serratus, obliques, pectoralis, latissimus dorsi, and deltoids.

The patient selection is critical and directly related to the outcomes and the patient satisfaction. Obese patients, with severe skin laxity or after massive weight loss are not good candidates due to the higher risks of complications and poor outcomes. The lack of adherence to a healthy lifestyle including physical activity and adequate diet also makes the patients bad candidates for the procedure.

The surgical planning begins with the anesthesia consultation and individual analysis of the patient. The marking process must be carefully done according to the patient particularities. The incisions are designed to reach all the desired areas and to get the best possible hidden scar.

The Procedure

To ensure an appropriate and safer emulsification of the fat, a tumescent solution with an infiltration/extraction ratio close to 2:1 must be administrated. The ultrasound emulsification must begin on the superficial layers using non-continuous mode (Vaser mode) and then emulsification on the deeper layers by using the continuous mode. Be extremely careful to avoid burns by the use of skin protection on the port, an adequate volume of infiltration, and protection from the body of the probe.

The use of vibration or power assistance to the vacuum extraction is a helpful way to facilitate and enhance the process by saving time, reducing the effort and blood loss.

The deep fat must be adequately removed and the superficial removal must be emphasized over the superficial muscle groups to define athletic depressions, such as the linea alba, lateral borders of the rectus, or the deltoid edges.

Fat grafting helps to restore volume and the appearance of the buttocks, deltoids, pectoralis in male, and breast in female. The graft technique is done according to the target area: for most cases decantation is enough, whereas for areas with less amount of graft needed, it is preferred to use inner thigh and lower abdomen fat for graft source and centrifugation with the aim of concentrating the largest possible amount of viable adipose tissue and stem cells [6].

Active drainage plays an important role in avoiding complications however its use is not universal; it is recommended to be used only in the places with high risk of seroma such as the lower back in males (Fig. 13.5).

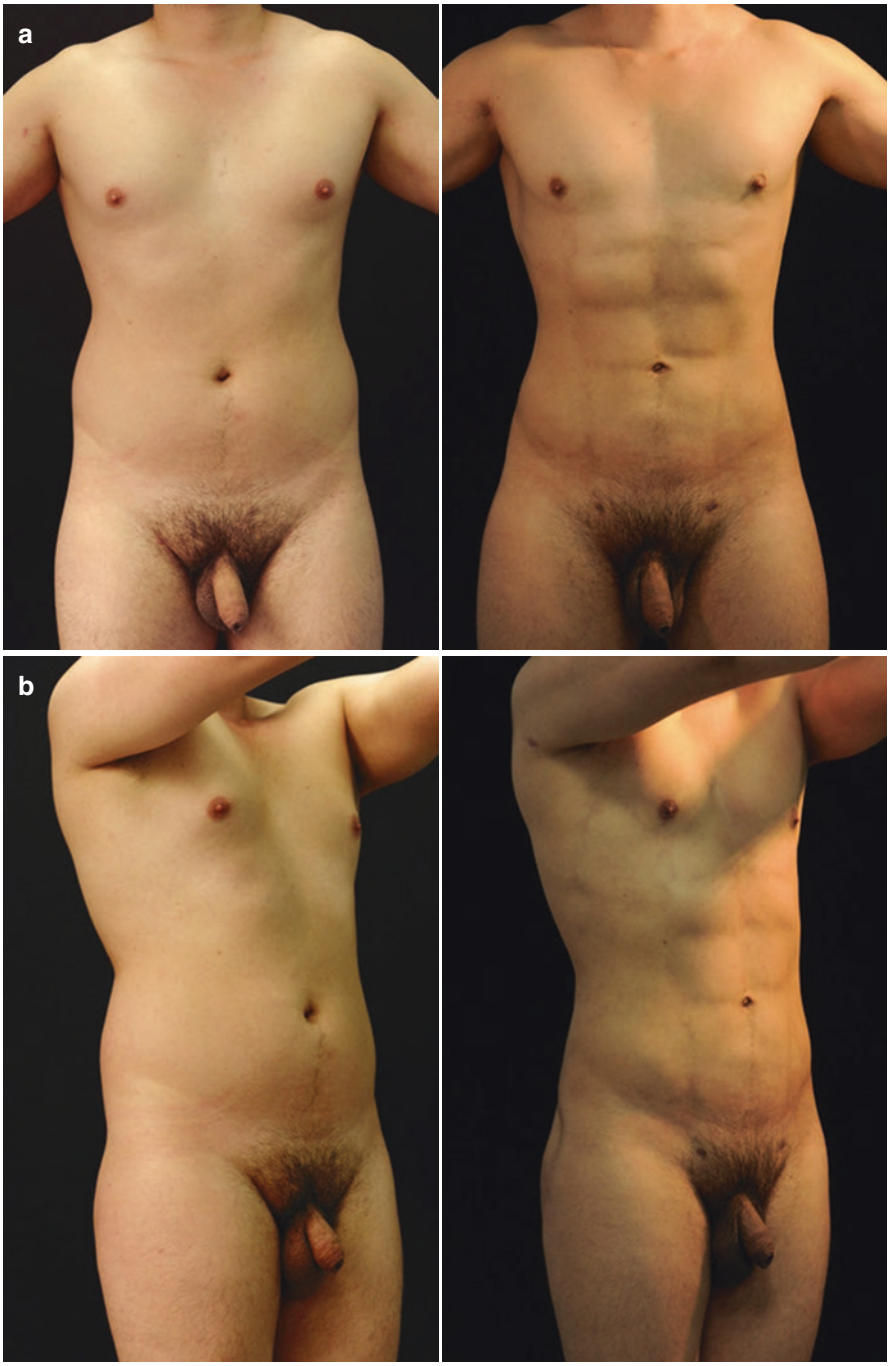

Fig. 13.5 Male (**a**) and (**b**). Notice the good skin retraction, little swelling, and bruising, showing a fast recovery using foam vest, garment, and drains

The care after the procedure is as important as the procedure itself. The use of the compression garments, the foam vest, and active drainage deals with the third space and loose skin created by the procedure. It helps in decreasing the recovery time and enhances the desired results.

The Evolution

The expanding curiosity and creativity of surgeons and technology are changing the way we treat patients. Even though there is rapid expansion and adoption of the new technology, there is still some resistance. It is up to the surgeon's criteria and training to embrace change, to adapt to new technologies, and to search for an accurate way to approach and resolve the patient's needs.

The new ideas are not only related to instrumentation, but they also are directed to questioning and rethinking the way the procedures are done. When skin resection procedures such as abdominoplasty are required for optimum skin draping, there have always been difficulties in achieving natural stigma-free results. To resolve this issue, each of the troublesome aspects including the navel shape and position, flat appearance, and high scar was considered, and the high-definition techniques were included which leads to achieving natural athletic results [7] (Fig. 13.6).

Managing patients after massive weight loss and post-partum has been always a challenge. In selected cases the patients can be approached by small abdominal incisions to perform the abdominal muscle plication and allowing some of the skin retraction to occur instead of a larger scar [8].

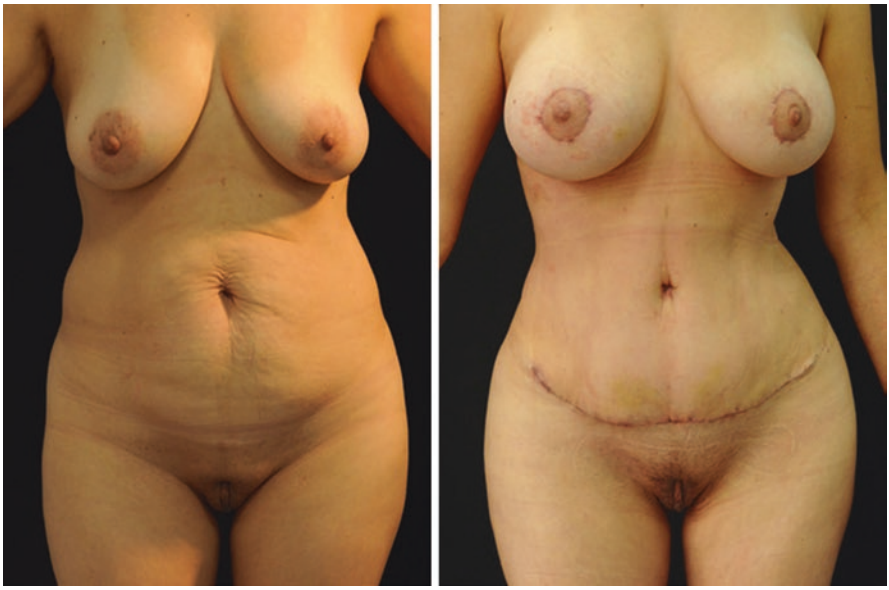

Fig. 13.6 (**a**) Presurgical image. The loose skin and stretch marks are noticeable. (**b**) Post surgical image 2 months after the surgery. The wound has a low position, the supraumbilical depression as well as the semilunaris lines are well defined and the umbilicus has a vertical young looking shape

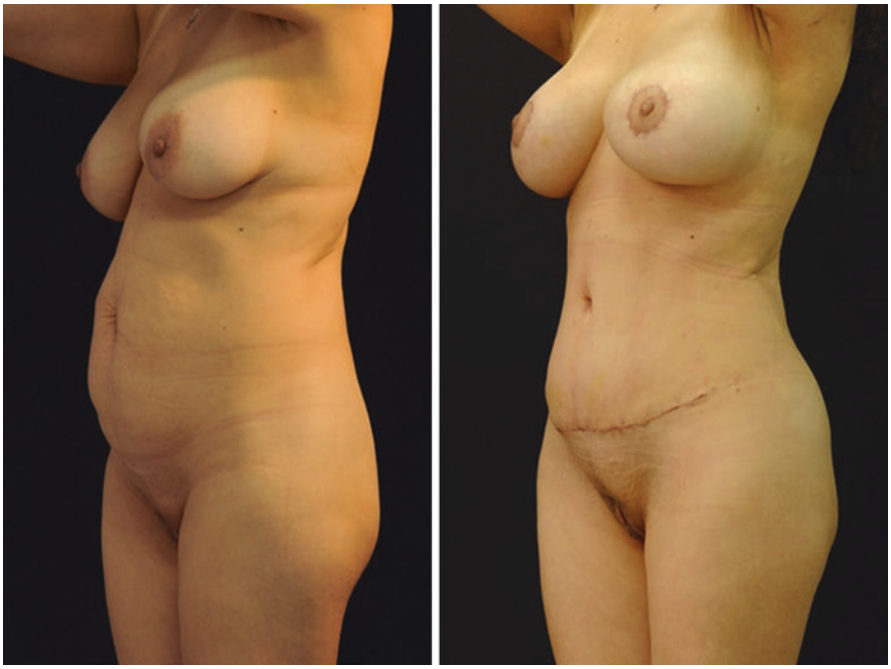

Fig. 13.6 (continued)

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Chapter 14
Ultrasound-Assisted Liposuction: Medicolegal Considerations

Neal R. Reisman

Liposuction remains a very common plastic surgical procedure. Ultrasound-assisted liposuction has become an integral component in treating patients with contour issues. Medical legal considerations can be divided into patient selection, inherent risks, general risks, and additional issues covering revision surgery and financial issues, to name a few. These are interesting times relating to patient expectations. Failing to meet patient expectations and goals remains a most common driver for litigation. Informed consent documents list common inherent risks which the patient acknowledges they understand and accept [1]. However some patients despite this understanding go on to file a lawsuit even after acknowledging such risks can occur and do [2]. There may be a number of factors leading to this observation including an increasing perception of unrealistic expectations and under emphasizing the fact that risks do occur despite excellent care [3]. It has been well accepted that appropriate patient selection remains the best method of avoiding litigation. A well-accepted method of patient expectation assessment utilizes Dr. Mark Gorney's Gorneygram that helps clarify the prospective patient's perception of their issue. Figure 14.1 plots deformity versus perception of deformity. Prospective patients who have minimal deformities yet perceive their problem is major have been a real concern about reaching their goal [4, 5].

The liposuction patient with minimal contour issues and "cellulite" concerns might be such a patient. It is questionable whether significant improvement and resolution can be achieved when minimal deformity is perceived as significant and life altering. I have seen cases where the areas were dramatically improved yet the patient was totally dissatisfied and led to litigation. This chapter will explore methods of avoiding problem patients and lastly managing litigation issues. The patient who has major concern for what you assess as a very minor deformity falls on the

N. R. Reisman (✉)
Baylor College of Medicine, CHI Baylor St. Luke's, Department of Plastic Surgery, Houston, TX, USA
e-mail: drreisman@drreisman.com

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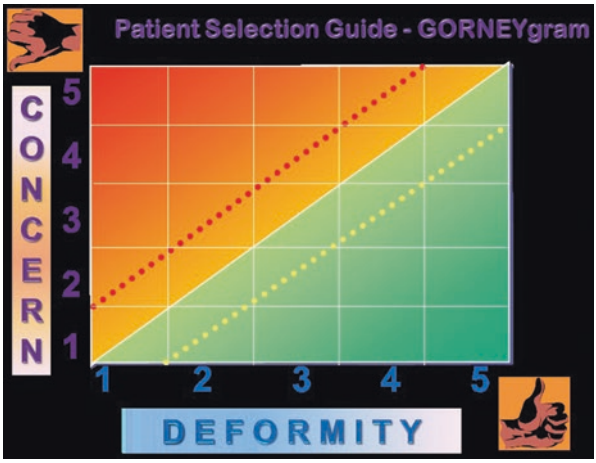

Fig. 14.1 Deformity versus perception of deformity

left side of this chart and should raise concerns about accepting. Perhaps additional visits with specific discussions about not being able to achieve their goal would be helpful. The prospective patient with significant asymmetric lipodystrophy who acknowledges they would like to see improvement and any level would fall on the right side of this chart and should be an acceptable patient choice. While this is not exact it can be helpful along with other interactions to assist in patient selection.

It is widely recommended to see patients at least twice before scheduling and performing surgery. These important visits allow a dialogue and exchange to elicit goals and expectations as well as specifically addressing such concerns. The Pennsylvania Supreme Court has held that there is a duty for the surgeon to interact with a prospective patient answering and discussing questions about an upcoming procedure. This suggests that a team approach consisting of a nurse, patient coordinator, and surgeon although appropriate cannot replace the surgeon's responsibility to direct discussions [6]. There is another factor that involves when the patient becomes more difficult either by stated goals or behavior. A trap might be to create the informed consent document more stringent outlining concerns and problems. Another solution might be to charge an increased amount acknowledging the specific difficulty the patient presents with. The concern is both apparent solutions acknowledge your assessment that goals and expectations are more difficult and perhaps a prudent surgeon would not have accepted the patient. What I am suggesting is by adding language or cost you may be admitting your lack of confidence in reaching the patient's goals. You may believe such actions help you should problems arise, but in fact these actions may work against you should litigation ensue.

I have suggested for many years to only accept prospective patients you "like" [6]. The initial consultation and subsequent interactions with your office can define the prospective patient. Listen to your staff's comments about how difficult the patient is and whether you can ever reach their goal without extreme stress. Let's say after two visits along with your staff waving red flags at you; you acknowledge this patient may not be suitable for your practice. How can you appropriately decline

to care for this prospective patient? I have used the phrase "I am not skilled enough to have you reach your expressed goals with this procedure." I have never regretted declining to care for such a patient although recognizing often a difficult decision. Patient selection is the key to avoiding medical legal issues. Patients do not pursue physicians they like and though more the doctor-patient relationship is good and preserved the less likely problems will arise even though complications might occur.

Informed consent is a process and not specifically the signed document in the record. The process of informed consent should include a number of consultations suitable for you to assess the prospective patient's goal and expectation as well as a dialogue outlining the procedure course, general risks, inherent risks, and additional instructions. The two standards available are information necessary for a "reasonable patient" to make an informed decision or information discussed that a "reasonable physician" would present. Explore your state's requirements for informed consent and whether there are described panels of necessary information to be included. There is often a balance between presenting a lot of information necessary to reach the goal of informed consent and not overwhelming a patient with protective information. Many of the available informed consent documents avoid legalese expressions and provide important information the patient can rely on making their experience improved. Litigation specifically from a lack of informed consent is actually rare but included in almost every lawsuit's claims. Just because a complication is listed may not necessarily protect you against a negligence claim. Use the informed consent process to flush out difficult and unrealistic patients.

Specific areas of informed consent include a revision policy and financial issues. I suggest there be a written revision policy an example of which might be no surgeon's fees for revisions within a year for patients who have met all their postoperative visits, instructions, and aftercare. It is also important to disclose their may be additional fees where anesthesia and facility costs are additionally required. This language hopefully prevents the patient who misses frequent visits, does not follow instructions, and then appears demanding a secondary procedure for correction.

Financial issues are similarly very important to discuss. Costs are to be paid in advance and if by credit card the patient waves HIPAA should a challenge to payment ensue. There have been cases where care has been provided and the patient challenges the payment on the credit card seeking a refund. When the credit card company asks your input about the service provided, HIPAA may prevent you from responding [7, 8]. This clause allows you to appropriately challenge the patient's request for a payback of their money for services already provided. There is also confusion about what might be included under coverage initially and for a revision. There should be a clear description of charges related to surgeon's fee, anesthesia, facility charge, lab and/or x-ray, and any additional items.

It is also wise to document that usually third party coverage is not available for aesthetic procedures. I have used a separate paragraph stating it would be fraudulent to submit a claim for such an aesthetic procedure and therefore no assignment will ever be accepted, which is irrevocable. There have been examples of fees collected for a cosmetic surgery procedure and the patient submits the claim to their insurance company which the surgeon participates. Surprisingly it is covered and the surgeon

must now refund the collected patient money and accept whatever the insurance company dictates. Having a documented discussion in advance should prevent such behavior.

There are general precautions involving photography and patient communications. It is advised to have a communication agreement in which the patient consents to how they may be contact whether by email, texting, social media, workplace, or regular mail. This should be updated frequently and adhere to. The use of any photography should be well understood requiring HIPAA consents for any photographs of the patient as part of the medical record and a commercial HIPAA photography consent should any patient results be utilized for advertising, marketing, or educational endeavors. The specific use for commercial pictures requires a description of where it will be used, the duration of use, distribution, and intended use all with scrubbing metadata from the photograph [6].

The informed consent process should cover general risks as with any surgery including but not limited to infection, bleeding, and the need for secondary surgery, delays in healing, unacceptable scarring, and the possibility of additional procedures. There are many other general risks to be considered as well as inherent risks specific to liposuction and ultrasound-assisted liposuction. I would be careful to not allow these risks to be minimized, allayed, or compromised by language or interactions. I have heard cases where the patient – plaintiff – stated "I've never had these happen but I have to tell them to you" or "these are so rare, I wouldn't worry." Such comments might lead to the occurrence of a complication clearly included, understood, and acknowledged by the patient who still believes if the surgeon were not negligent such complications would never occur. This sets up the most difficult condition of having to be perfect in all areas despite the patient's problems, health status, or unrealistic goals. Complications and inherent risks are presented for a reason and should demonstrate that no procedure is without risk. The informed consent process should help achieve a balance between benefits of any procedure and risks discussed. The more risks applicable the more questionable the procedure becomes.

Inherent risks of liposuction should be discussed specific to the patient. These may include contour irregularities, laxity, and perception of increased cellulite, adherence, and asymmetries. Ultrasound-assisted liposuction may require additional disclosures about burns of the skin and deeper tissue due to ultrasound energy and potential cannula fragmentation. Ultrasound-assisted liposuction has been utilized for many years and risks of fragmentation or other unknown effects of ultrasound therapy usage remain rare. Patients seldom recognize their asymmetries in advance and it is wise with the use of photography to present anatomy in advance demonstrating their variances [6]. Showing the same variations after surgery can be interpreted as making excuses! Excess removal below the buttock fold may assist in buttock laxity and droop. The ultrasound-assisted liposuction incision may be more vulnerable to scarring and thinning and its placement should therefore be discussed with the patient.

Anesthetic considerations are also very important. Abdominal liposuction in a patient with abdominal breathing such as with a LMA use may expose the patient to

fascial penetration with disastrous results. Be cognizant that tumescent injections with a smaller multi-port cannula may be easier to perforate muscle in a patient with abdominal breathing motion. Injury to deeper superficial structures has always been a component of informed consent while deeper abdominal cavity penetration falls outside of an acceptable range of complications. Great care should be exerted to know exactly where the cannulas are at any given time [6].

Similarly the operating room environment should receive some comment. Many patients undergoing liposuction are unclothed and susceptible to lower operating room temperatures. Care should be given to either warm up the room or use other technology to keep the patient appropriately warm without compromising sterility. The volumes of tumescent fluid utilized also deserve a comment. It may be important to consider the type and volume of Xylocaine and epinephrine utilized in tumescent fluid being appropriate for the patient's age and medical history.

Aftercare involving garments should be discussed as there have been a number of compression deformities appearing to be the result of a too tight or folding garment. The type of compression and pitfalls should be discussed in document. In addition aftercare might consist of gentle massage to help reduce or prevent adherence which may cause contour irregularities. Demonstrating to the patient the type of massage, duration, and intensity would be helpful.

Large-volume liposuction maybe defined as greater than 5 liters of aspirate in one setting has its own standards that help reduce complications. These precautions include monitoring the patient in a controlled environment for at least 23 hours. The third space fluid shifts can result in significant complications and death. The levels of Xylocaine and epinephrine used in the tumescent fluid infusions must be assessed to avoid overdosage of either drug.

A Template of Informed Consent Discussions Maybe as Follows:

- Alternative Treatment
- Risks of Liposuction Surgery
- Inherent Risks of Liposuction
- Patient Selection:
- Pubic Distortion:
- Umbilicus:
- Tumescent Liposuction:
- Ultrasound-Assisted Lipectomy:
  - Burns:
  - Cannula Fragmentation:
  - Unknown Risks:
- General Risks of Surgery
- Healing Issues:

- Bleeding:
- Infection:
- Scarring:
- Firmness:
- Change in Skin Sensation:
- Skin Contour Irregularities:
- Skin Discoloration/Swelling:
- Skin Sensitivity:
- Major Wound Separation:
- Sutures:
- Delayed Healing:
- Damage to Deeper Structures:
- Fat Necrosis:
- Seroma:
- Surgical Anesthesia:
- Shock:
- Pain:
- Cardiac and Pulmonary Complications:
- Venous Thrombosis and Sequelae:
- Allergic Reactions:
- Drug Reactions:
- Asymmetry:
- Surgical Wetting Solutions:
- Persistent Swelling (Lymphedema):
- Unsatisfactory Result:
- Additional Advisories
- Smoking, Second-Hand Smoke Exposure, Nicotine Products
- Sleep Apnea/CPAP
- Medications and Herbal Dietary Supplements:
- Sun Exposure – Direct or Tanning Salon:
- Travel Plans:
- Body-Piercing Procedures:
- Female Patient Information:
- Intimate Relations After Surgery:
- Mental Health Disorders and Elective Surgery:
- DVT/PE Risks and Advisory
- Additional Surgery Necessary (Re-Operations)
- Patient Compliance
- Revision Policy
- Health Insurance
- Financial Responsibilities
- Cosmetic Surgery Financial Agreement:
- Communication Acknowledgement – Consent
- Consent to Commercial Use of Photographs.
- Patient Consent for Use of Credit Cards, Debit Card, and Financing – Disclosure of Protected Health Information.

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