A Closer Look: Understanding the Differences Between Laser Lipolysis and VASER® Ultrasonic Lipoplasty

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Background

Modern lipoplasty was introduced in the late 1970s by Dr. Yves-Gerard Illouz and was accomplished with the infusion of fluid via a blunt cannula accompanied by high-vacuum suction. The 1980s brought the advent of the tumescent technique and lipoplasty was moved from the operating room to the outpatient setting. Today, lipoplasty is the most common cosmetic surgery performed in the United States, with laser lipolysis and ultrasound-assisted lipoplasty (UAL) being two of the most widely used new modalities.

Laser Lipolysis

Laser lipolysis was first developed in Europe and South America in the 1990s, and involves focusing a narrow beam of light across a very short distance, completely destroying the tissue within the target area. During the procedure a small cannula, typically 1.0 mm to 2.0 mm in diameter, containing a thin laser fiber is inserted into the target area. The cannula is moved back and forth delivering high intensity light energy and causing disruption of tissue, including adipocyte (fat cell) rupture, coagulation of small blood vessels, and reorganization of the reticular dermis (Figure 1). Proponents of laser lipolysis cite reduced bruising in the acute recovery phase, minimal blood loss, and the ability to promote skin tightening as benefits of this procedure. However, negative effects may include cauterization of blood vessels, destruction of viable fat cells, and lack of purported tissue-specific activity. During laser lipolysis, the laser light is nearly completely absorbed, irrespective of light wavelength or tissue type, resulting in rapid heating, tissue ablation, and necrosis. The surrounding tissue may be inadvertently subjected to temperatures well above those which denature proteins and cause collagen shrinkage.

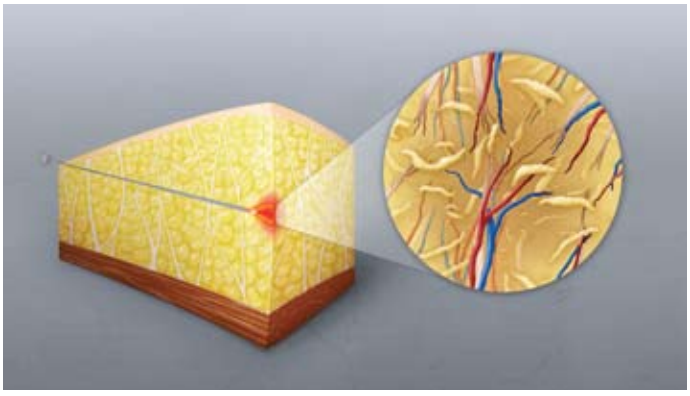

Figure 1: Laser lipolysis tissue effects

VASER Ultrasonic Lipoplasty

VASER ultrasonic lipoplasty utilizes the VASER Lipo System, a third-generation UAL device. VASER technology employs mechanical and acoustic forces to emulsify fat within the target area, and unlike laser modalities, does not heat or destroy the fat cells.

During body contouring with VASER Lipo, a tumescent fluid is infused throughout the target area. 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 adipose (fatty) tissue, the tumescent fluid surrounds the fat cells, allowing the gas bubbles to infiltrate between individual cells. However, the tight junctions between cells within blood vessel walls and connective tissues prevent gas bubbles from affecting these tissues.

The VASER system delivers ultrasound pressure waves, or alternating regions of higher and lower pressure, at 36,000 Hz via a titanium probe. These waves 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 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 (Figure 2). This results in the microbubbles rapidly expanding from 5-10 microns to approximately 180 microns, allowing the bubbles to act as a wedge between the fat cells,

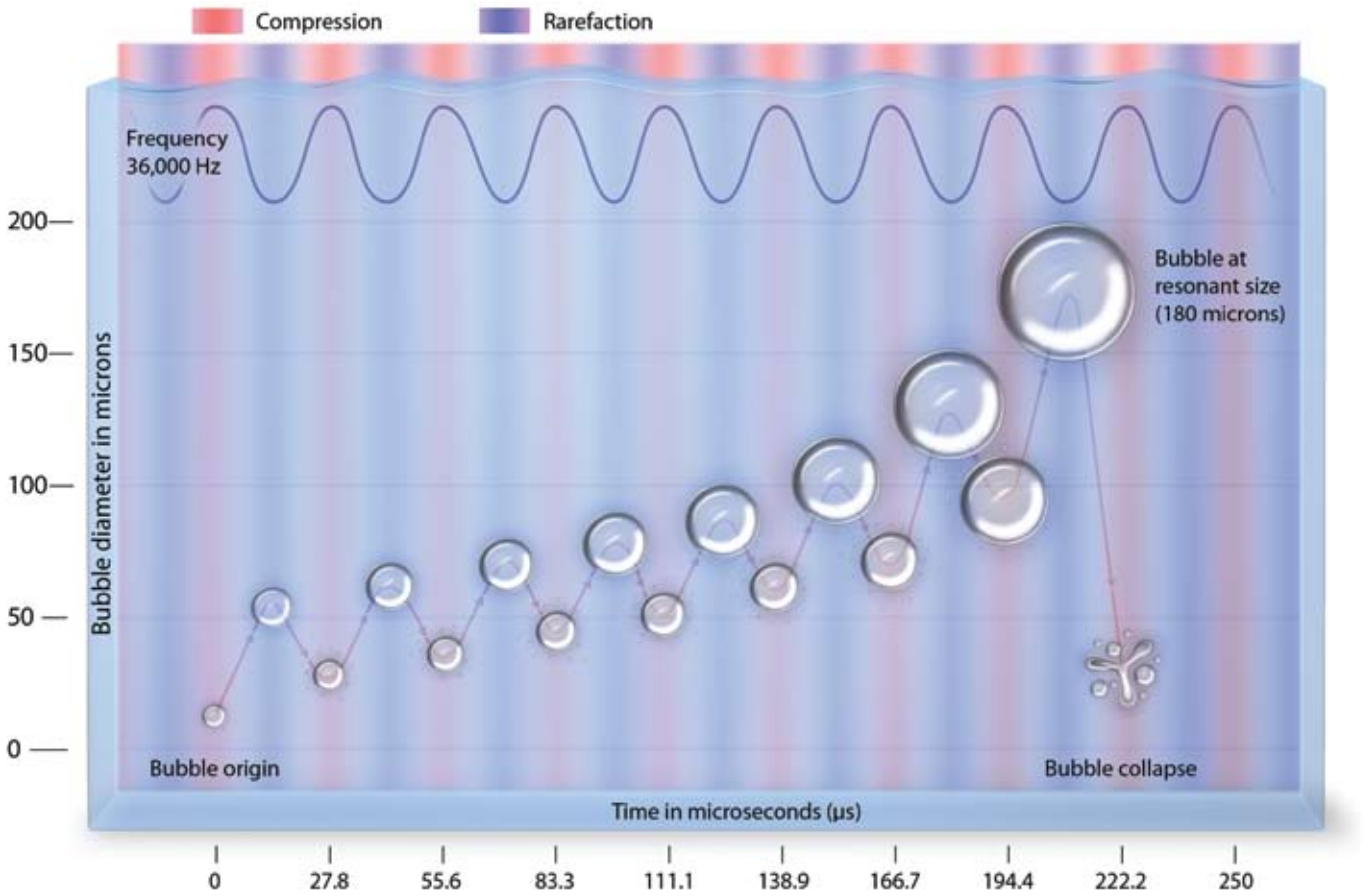

Figure 2: Growth of microbubbles in infusion fluid via compression and rarefaction

dislodging the cells from the adipose matrix (Figures 3 & 4). This process of gas bubble action is called cavitation. Since adipose cells contain no gas, the individual cells are unaffected by this process since they cannot cavitate. 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 is the source of the natural tissue selectivity of VASER technology. As the lipocytes are displaced, they are mixed with the tumescent fluid by a process called acoustic streaming, resulting in a complete emulsion of the fat cells, which are subsequently aspirated (Figure 5).

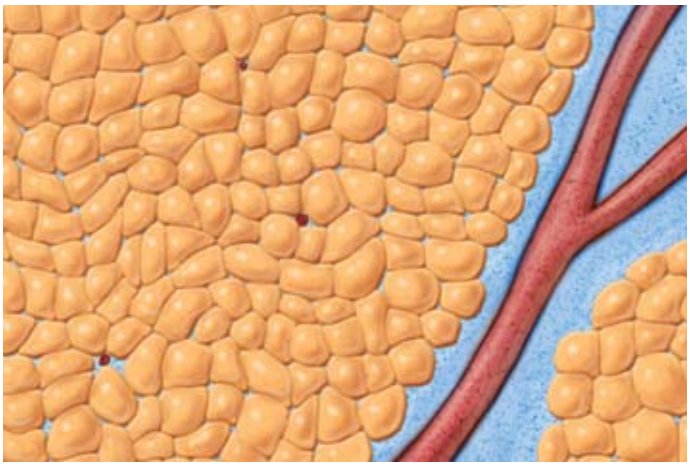

Figure 3: Fat cells surrounded by infusion fluid

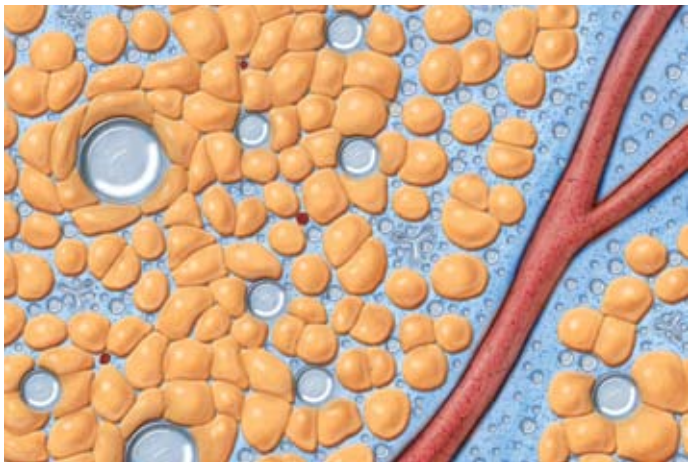

Figure 4: Fat cells being dislodged via cavitation

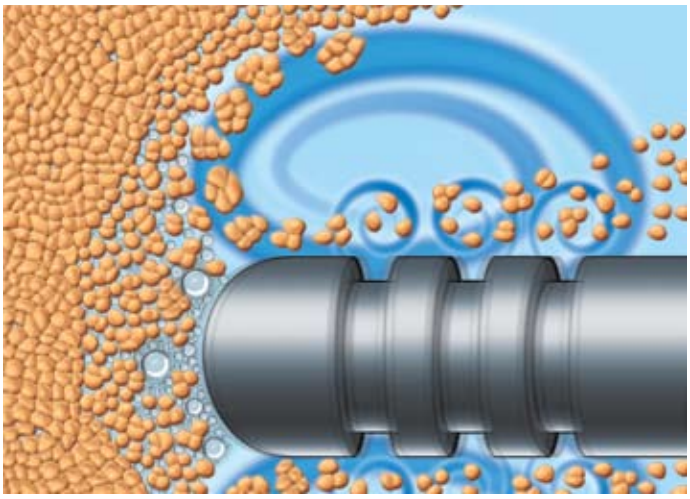

Figure 5: Acoustic streaming

The benefits of the VASER Lipo System include tissue specificity, limited blood loss, adaptability to both small- and large-volume procedures based on physician choice of probe, ability to combine with other procedures, and preservation of fat cell viability. Since individual fat cells remain intact, fat collected during the VASER Lipo procedure may be harvested for autologous fat transfer (AFT). The fat aspirated during VASER Lipo is refined 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, and has been associated with central necrosis and sheer force disruption during AFT. Fat cannot be harvested from laser lipolysis, because the procedure completely evaporates or lyses all the cellular structures in contact with the laser tip.

Comparing a 25W Laser with a VASER Probe

A recent study exposed bovine fat infused with saline to laser energy (25W, 980nm, 1-second duration) and to VASER ultrasound energy (100% setting, 3.7 mm, 2-ring probe, 1-second duration). Tissue exposed to the laser reached 50°C (ability to denature proteins) in less than 50 milliseconds and 100°C (boiling point) in 100 milliseconds (Figure 6). Data extrapolation estimated the highest temperature to reach 484°C. In comparison, at 1 second of use, the tissue exposed to the VASER probe increased only 9°C. The study authors concluded that the laser system produced extremely high, uncontrolled

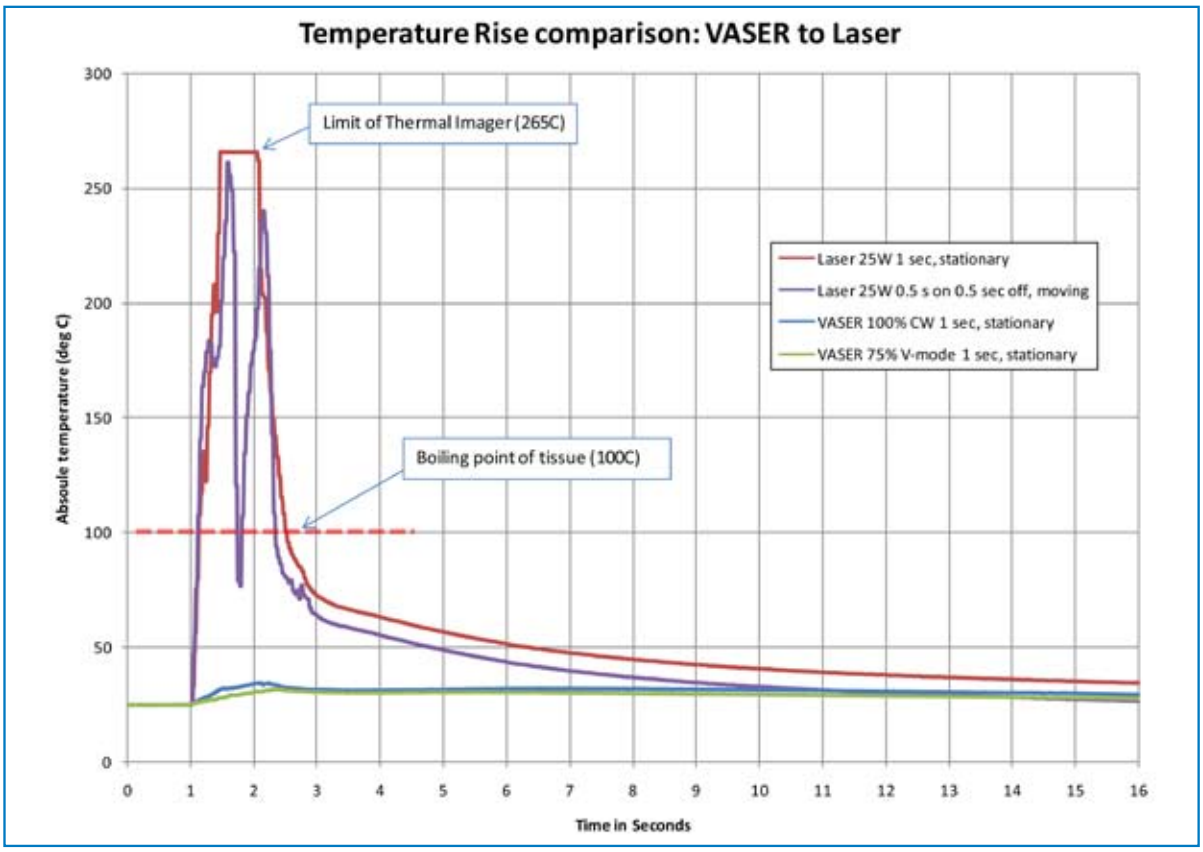

Figure 6: Temperature data

temperatures that were sufficient to vaporize tissue and damage structures within the body. Conversely, the VASER probe did not produce damaging temperatures.

Summary

Advances in lipoplasty have allowed for the feasibility of in-office, wide awake procedures. The availability of multiple modalities, including laser lipolysis and VASER Lipo, offer physicians and patients the ability to customize procedures. While laser lipolysis has become well known for limiting blood loss and improving recovery time, it is limited to small procedures and does not allow for harvesting of viable fat cells for additional procedures. As more powerful lasers have come onto the market, issues of patient safety and the possibility of severe burns have become more critical. VASER Lipo utilizes acoustic forces to safely dislodge adipocytes while protecting surrounding tissues, ultimately producing a clean, smooth aspirate with excellent cell viability, which may be used for concurrent treatments such as AFT.

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Dr. Schafer is an internationally recognized expert in ultrasonic technology, with over 25 years of design and development experience. He is currently Vice President of the Ultrasonic Industry Association (UIA), Chairman of the National Electrical Manufacturers Association (NEMA) Ultrasound Technical Committee, and serves on the Board of Governors of the American Institute of Ultrasound in Medicine (AIUM). Dr. Schafer holds a Ph.D. in Biomedical Engineering from Drexel University, an M.S. in Acoustics from Pennsylvania State University and a B.S. in Electrical Engineering from the Massachusetts Institute of Technology. He has been published over 40 times and has been issued 13 patents.