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CHAPTER 29

Laser-Assisted Liposuction

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Summary

Over the last four decades, advances in liposuction have led to improved, safe, efficacious, and aesthetic outcomes. Laser-assisted liposuction marks one of the latest advances in body contouring. The addition of energy to selectively photothermolyse adipose tissue and subsequently remove the fat have been shown to be safe and efficacious both under local as well as general anesthesia. In this chapter, the authors describe their preferred technique, using the 1,440-nm Nd:YAG wavelength because of its high affinity for fat as a chromophore without excessive heat production. The authors have experienced low complication rates (0.001%) in over 1,000 consecutive patients with high satisfaction rates.

Keywords: body contouring, laser-assisted liposuction, liposuction

Introduction

Liposuction, first introduced by Illouz[1] in 1982,[2] has become among the most commonly performed cosmetic procedures in the United States. The technique of liposuction and the technology used to perform it have evolved significantly over the past 40 years. While suction-assisted liposuction (SAL) remains the most common technique among plastic surgeons today, newer technologies, including ultrasound-assisted liposuction,[3,4,5] radiofrequency,[6,7,8] power-assisted liposuction (PAL),[9,10,11] and laser-assisted liposuction (LAL) have increased in popularity.[12,13,14] The use of these technologies in conjunction with liposuction has led to benefits of fat emulsification, skin tightening, decreased blood loss, decreased postoperative pain, and reduced surgeon fatigue.[15,16,17,18]

The first laser-assisted lipectomy device was approved by the United States Food and Drug Administration in 2006.[19] The use of energy at various wavelengths to emulsify and remove fat has been shown to improve efficacy and safety when performed either under general or local anesthesia.[12,14,20] The goal of LAL is to utilize a wavelength of energy that provides selective photothermolysis and adipocyte cell death while minimizing thermal injury to surrounding tissues. Currently, the most commonly used lasers for LAL are the Nd:YAG 2,010, 1,440, 1,320, 1,064, 980, 975, and 924 nm.[19, 21, 22] Many of the devices utilize more than one wavelength during treatment. The procedure involves insertion of a laser fiber via a small skin incision. The fiber may either be housed within a cannula or as a separate fiber. The safety of LAL has been improved by the addition of internal temperature probes and accelerometers that disable the laser if temperatures pass a safe threshold or if the cannula stops moving. The Nd:YAG 1,440-nm device has been preferred by the authors as it targets fat more than water, improving safety and predictability of the procedure.

Physical Evaluation

- Thorough medical history should be elicited, including review of current medications, supplements, conditions that may increase the risk of bleeding, or deep venous thrombosis (i.e., chronic venous insufficiency, obesity, trauma, contraceptive use, hormone replacement therapy, etc.).

- Document height, weight, and circumferences of relevant body areas. In the authors' practice, patients with body mass index exceeding 30 kg/m^2 are referred for weight loss prior to surgery.
- Assess fat distribution and utilize pinch testing to determine relative thickness and composition of subcutaneous fat.
- Notate areas of fascial adherence.
- Site-specific evaluation is important. Carefully examine for traumatic or surgical scars, hernias, venous insufficiency, etc. If there is concern for abdominal hernia or diastasis, an ultrasound or computed tomography scan may further clarify the anatomy.
- Carefully evaluate skin with attention to skin elasticity to ensure adequate retraction postprocedure. Assess associated wrinkles, laxity, surface irregularities, and presence of cellulite.
- Mark the patient in front of a mirror for both the surgeon and patient to agree on treatment areas, as well as point out areas of contour irregularities.

Anatomy

For the purposes of liposuction, the subcutaneous tissue throughout the body can be divided into three layers: superficial, intermediate, and deep. This contrasts with anatomical texts, which divide the subcutaneous tissue into superficial and deep layers divided by a superficial facial plane. Different body areas have characteristic thickness and consistency specific to each layer. For example, the flanks typically have more fibrous tissue than central abdomen, and the back tends to have more fibrous and compact superficial and middle layers with less compact deep layers. These specific areas are important for the surgeon to assess to avoid contour irregularities.

It is helpful to classify patients based on their degree of body habitus as well as skin excess. For example, younger patients tend to have localized areas of lipodystrophy with good skin tone and minimal skin irregularities, other patients may have generalized lipodystrophy with slightly diminished skin tone and slight skin irregularities, and last, certain patients may have significant skin redundancy and lipodystrophy that may be more amendable to excisional operative procedures to improve shape and contour with or without liposuction as an adjunct.

Anatomical "zones of adherence" or fibrous attachments to the deep fascia are important to recognize. Depending on the patients' aesthetic goals, these fibrous attachments may be disrupted to allow for soft-tissue redistribution or may be avoided, depending on the clinical circumstances.

Cellulite is dimpling of the skin (usually in the thigh or buttock area) that is thought to be related to fibrous, dermal attachments to underlaying facial and hypertrophied fat. Liposuction in these areas may soften or even accentuate the appearance of cellulite.

Steps for Laser-Assisted Liposuction

LAL includes several devices with varying wavelengths targeted to selectively photothermolyse fat and/or water. The authors employ a four-stage technique as follows:

1. Infiltration of tumescent fluid.
2. Application of energy to subcutaneous tissues.
3. Evacuation via suction device.
4. Subdermal skin stimulation.

One of the key measures of efficacy and safety in LAL is selection of appropriate wavelength to target appropriate chromophores. The preferred wavelength used by authors exceeds 1,100 nm, as it has much greater absorption coefficient for lipids and water than those in the 900-nm range. This allows for more efficient energy transfer.[20]

On the day of surgery, the areas to be treated are marked with the patient standing in an upright position. Typically, circles are used to mark the target treatment areas, while hashmarks are utilized to mark the areas of fascial adherence or areas the surgeon wishes to avoid. For patients undergoing LAL under local anesthesia, 10 mg of oral diazepam and one tablet of hydrocodone with acetaminophen are given. One dose of oral antibiotics is also given preoperatively (cephalexin or ciprofloxacin). After standard sterile prep and draping, the incision sites are injected with 1% lidocaine with epinephrine. A 14-gauge needle is used for puncture site access to allow the introduction of an infiltration cannula or a 20-gauge spinal needle. The tumescent infiltration technique is utilized with injection into the deep and intermediate subcutaneous tissues. The composition of the tumescent includes Ringer's lactate solution containing 0.1% to 0.15% lidocaine, 12 mL of sodium bicarbonate, and 1.5 mL of a 1:1,000 epinephrine concentration.

After satisfactory tumescent infiltration, the 1,440-nm Nd:YAG laser at a frequency of 40 Hz was used through fiberoptic cables with diameters of 300, 600, and 1,000 µm. The applied power setting ranges from 7 to 30 W, with a total energy application ranging from 2,000 to 64,000 J per site.[20,23]

The fiberoptic cannula is placed in the deep and intermediate subcutaneous layers moving at a rate of at least 1 cm/s to avoid thermal injury. Careful attention is paid to bony prominences, curvatures, and avoidance of "end-hit" thermal burns. In these areas, the laser is turned off to minimize any complication.

SAL is then performed using manual 2- to 3-mm Mercedes style–tip cannulas or 3- to 5-mm Mercedes style–tip PAL cannula in the same subcutaneous planes. In areas where greater than 1 L of total aspirate is removed, the authors prefer to leave a closed suction drain. All access incisions are then closed with 5–0 nylon suture, and patients are placed in compression garments.

Postoperative Care

The benefit of LAL under local anesthesia is that patients are conversant during the operation and have little pain postprocedure. Also, the authors believe that local anesthesia improves the safety of liposuction, as patients can alert the surgeon of any unlikely fascial violation. At the conclusion of surgery, patients are placed in a compression garment that is customized to the surgeon preference and the procedure performed. Compression foam may also be used under the garment to assist in contouring and improve edema. After surgery, patients are hydrated with at least 500 cc of fluid prior to same day discharge with an escort. Patients are encouraged to ambulate the day of surgery and may shower on postoperative day 1. Routine follow-up visits take place on postoperative day 7 and 60. Most patients report return to normal daily activity within 36 hours of the procedure. Patients are alerted that edema tends to peak from 3 to 5 days after surgery and that any bruising should be minimal and expected to dissipate by 1 week after surgery.

Management of Complications

Potential complications include thermal injury, cellulitis, contour irregularities, changes in pigmentation, hematoma, and seroma. Most of these complications are rare and not unique to LAL alone, as they have been associated with other body-contouring techniques with and without energy application.

In experienced hands, LAL is safe and has minimal complications. When surgeons begin utilizing LAL in their practice, it is important to acclimate to the device settings and to be cognizant of power settings used in different body areas. For example, the dermis of the neck is far thinner than that of the back and power settings should be adjusted accordingly to prevent thermal injury.

There are several important technical considerations when performing LAL that must be considered. Tumescent fluid serves as a "heat sink" that helps protect against thermal injury. Topography of the skin is also less consistent once tumescent fluid has been aspirated off. The authors caution against reintroducing the optic fiber after initial treatment and aspiration, as there is less tumescent fluid present to protect against thermal injury, and skin topography is less uniform, leading to more potential "end-hits."

In the authors' experience, with 1,000 consecutive LAL with 1,440-nm wavelength device under local anesthesia, there was one (0.001%) reported complication of hematoma after a male patient self-aspirated the treated area 5 days postoperatively using an 18-gauge needle and syringe.[20] This is consistent with a previous report by the senior authors showing 1,000 consecutive cases using 1.064- and/or 1,320-nm Nd:YAG with a complication rate of 0.007%.[20,23]

Case Examples

Case No. 1: Laser-Assisted Liposuction in a 38-Year-Old Man (Fig. 29.1)

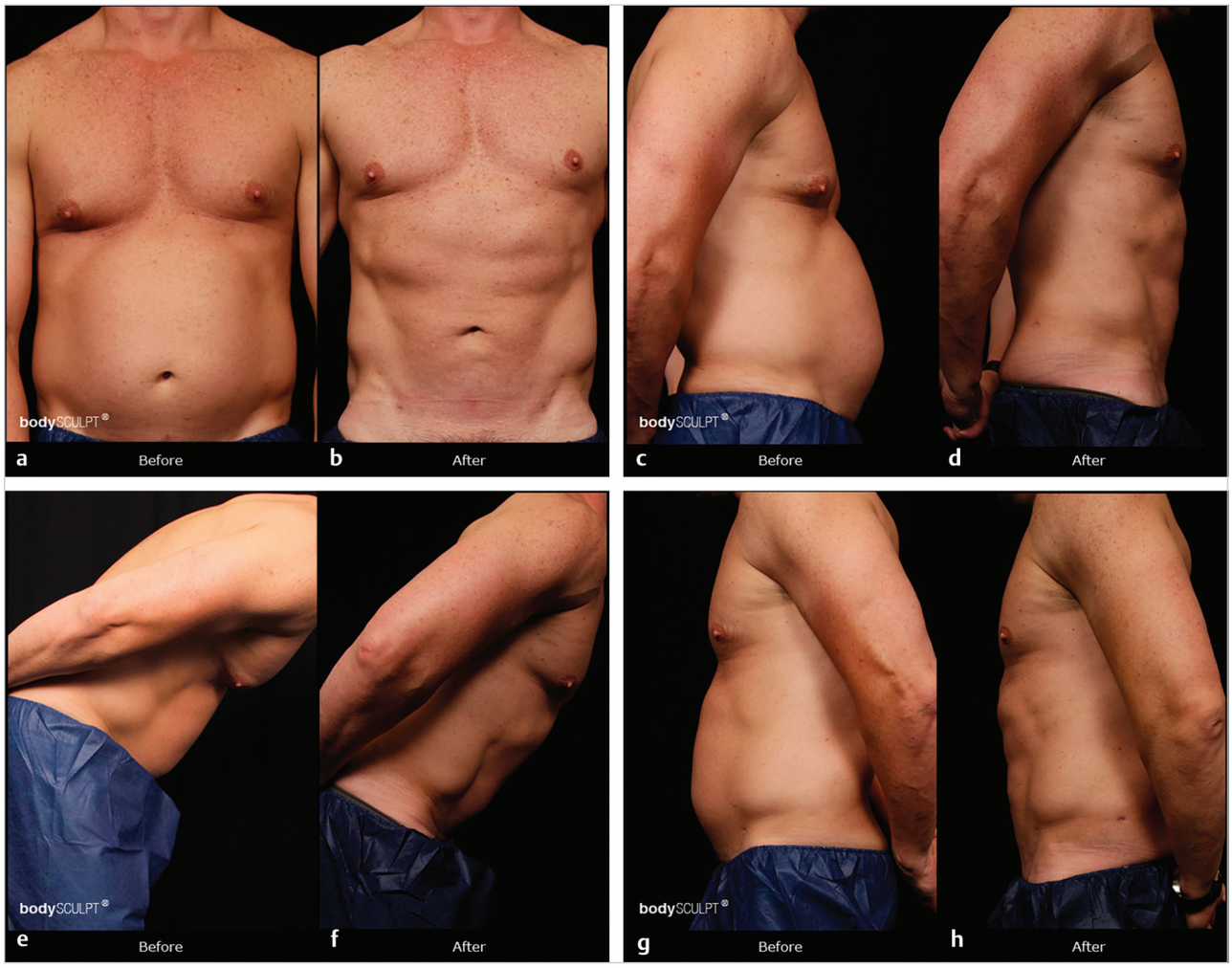

Fig. 29.1 Laser-assisted liposuction was performed on this 38-year-old man. The composition of the tumescent includes Ringer's lactate solution containing 0.1% to 0.15% lidocaine, 12 mL of sodium bicarbonate, and 1.5 mL of a 1:1,000 epinephrine concentration. The 1,440-nm Nd:YAG laser at a frequency of 40 Hz was used through fiberoptic cables with diameters of 300, 600, and 1,000 µm. The applied power setting ranges from 7 to 30 W, with a total energy application ranging from 2,000 to 64,000 J per site. Suction-assisted liposuction is then performed using manual 2- to 3-mm Mercedes style–tip cannulas or 3- to 5-mm Mercedes style–tip power-assisted liposuction cannula in the same subcutaneous planes. All access incisions are then closed with 5–0 nylon suture, and patients are placed in compression garments. Postoperatively, improved contour and definition can be seen at 14 months.

(*Continued*)

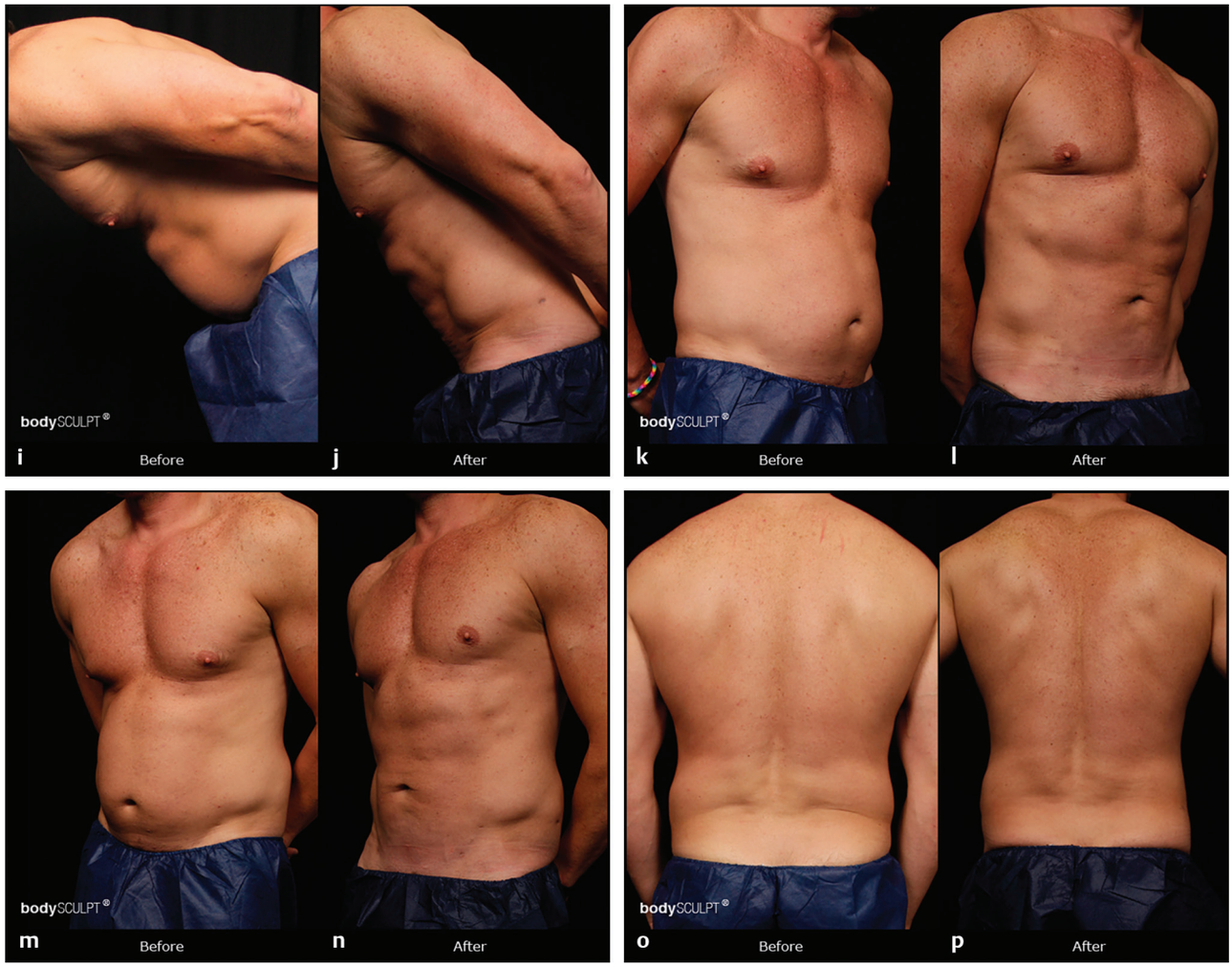

Fig. 29.1 (*Continued*)

Pearls and Pitfalls

Pearls

- Nd-YAG 1,440-nm laser can be safely used to achieve satisfactory results in body contouring with minimal complications.
- Laser liposuction can be successfully performed under local anesthesia and sedation.

Pitfalls

1. Avoid using the laser fiber directly under dermis, where the subdermal plexus resides. This may lead to "tattooing" from hemosiderin pigment extravasation from lysed red blood cells, paresthesias, and burns.
2. Avoid "end-hits."
3. Be cautious when retreating areas after tumescent has been liposuctioned away, as heat will not be dissipated when tumescent was in the area.

Bulleted Steps

Steps for Laser-Assisted Liposuction

1. Most patients undergo LAL performed under tumescent local anesthesia with oral sedation (10-mg diazepam, 5-mg hydrocodone or 325-mg acetaminophen, 500-mg cephalexin, or 500-mg ciprofloxacin).
2. Tumescent solution for local anesthesia includes 0.10% lidocaine and 1:750,000 epinephrine with 10 mEq sodium bicarbonate.
3. General anesthesia was used primarily based on patient preference or if patients were undergoing secondary procedures. Tumescent solution for general anesthesia includes 0.04% lidocaine with 1:1,000,000 epinephrine.
4. The 1,440-nm wavelength Nd:YAG laser (Cynosure, Westford, MA) is used selectively photothermolyse deep and intermediate layers of subcutaneous fat.
5. After adequate fat emulsification, PAL is used for fat removal using 3- and 4-mm diameter blunt-tip cannulas with double Mercedes-style openings. For small regions, manual blunt tri-Mercedes-style cannulas from 2- to 3-mm diameter are used.
6. Once satisfactory contour is achieved, the patient is placed in a compressive garment and discharged the same day.

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