10 Radiofrequency-Assisted Liposuction for Body Contouring

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Abstract
Body contouring has been addressed through liposuction alone or with skin excision procedures. Traditionally, only individuals with relatively mild skin excess could be managed with liposuction alone. There has long been a need for a technology that can safely and reproducibly tighten skin without lengthy incisions. Radiofrequency (RF) induced thermal contraction has been used in various medical and surgical specialties for many years but was only approved by the FDA in 2016 to assist in body contouring. The radiofrequency-assisted liposuction (RFAL) device Bodytite (Inmode, Ltd, Toronto, Canada) utilizes this effective technology to specifically heat the subcutaneous tissue and the skin in an effective, safe, and reproducible way. In this chapter, we offer an overview of the Bodytite device including the built-in safeguards, a guide to proper patient selection, and highlight the pearls and pitfalls of this exciting technology. RFAL is a powerful tool for thermal contraction of the soft tissues throughout the body in properly selected cases.

Keywords: Body contouring, liposuction, radiofrequency, radiofrequency-assisted liposuction, RFAL

10.1 Radiofrequency Technology

Liposuction has increasingly become the most sought after body contouring procedure internationally. However, the goal of achieving concomitant skin tightening in liposuction has been elusive at best. The need for a device that can accomplish tissue heating in a safe and reproducible way leading to skin contraction without lengthy incisions can have immeasurable benefits to patients. The use of RF was initially reported in the literature as a noninvasive device. It has led to the use of RF as an energy-based platform for body contouring with FDA approval in 2016.

The elusive goal of achieving skin tightening in liposuction has been attempted with laser assisted liposuction (LAL).[1] Paul et al introduced RFAL technology in 2009 and showed linear contraction at 12 months of up to 47%.[2,3] Unlike laser liposuction the focus of the energy is not directed at the dermis per say but at a deeper level. The ability to heat and treat large volumes of tissue, due to RF's ability to be utilized in the subcutaneous and deep adipose tissue without compromising skin safety, has been the mainstay of RFAL technology. This process of thermal enhanced remodeling of the soft tissue leading to skin tightening has led to the use of RFAL in patients who would otherwise be marginal or poor candidates for traditional liposuction techniques.

10.2 RFAL: Mechanism of Action

RF thermal-induced contraction has been described in medicine in various applications such as vein ablation, orthopedics, and ophthalmology.

Contraction of the collagen fibers occurs at different temperatures depending on the type of collagen. The optimal temperature for collagen contracture has been reported to be 60–80°C.[4] This contraction does not necessarily cause connective tissue damage but instead induces a restructuring effect of the collagen fiber framework. Once the tissue reaches the threshold temperature it immediately undergoes contraction in a dramatic fashion. This effect has been described in studies of the cornea, cartilage, and vascular tissue in the past. RF energy is applied internally directly to the deep adipose and subcutaneous tissue with lower heat levels applied to the dermis. This results in tissue contraction that occurs mainly due to the contribution of deeper adipo-fascial layers. Specifically, heating of the Fibro-Septal Network (FSN) leads to dermal contraction (▶Fig. 10.1).

The target temperature at which soft tissue matrix contracture optimally occurs is 38–42°C.[5] The internal measured temperature can range from 55–70°C however this is only relevant as it relates to the external temperature reading. In other words, the endpoint of 38–42°C measured externally should be reached in order to achieve the desired result of dermal tightening.

10.3 RF Device

The RFAL device Bodytite (Inmode, Ltd, Toronto, Canada) consists of a handpiece with two electrodes attached to an RF power source (▶Fig. 10.2). The internal electrode is coated with a Teflon tip in order to avoid end hit injuries. It has a conductive tip that emits RF energy that flows between the internal electrode and the external electrode which in turn overlies the surface of the skin. An energy field is thus created between the two electrodes that

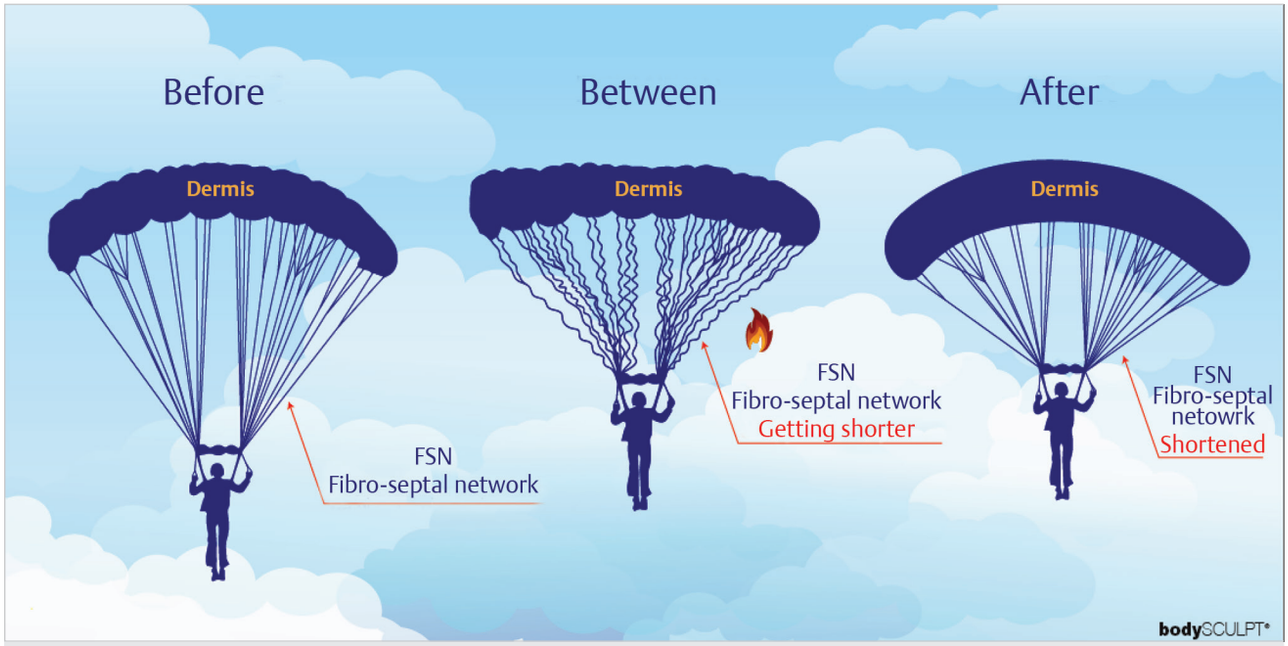

Fig. 10.1 Parachute + cross-section.

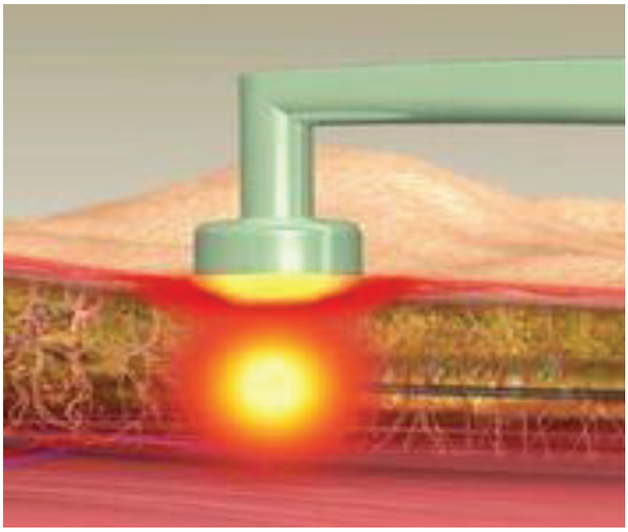

Fig. 10.2 RFAL device, Bodytite.

translates into a thermal effect on the interposed tissues. Once the area to be treated is tumesced the internal probe is inserted and is passed back and forth in smooth liposuction-like strokes. At the same time the external probe glides in tandem along the surface of the skin. The skin has been prepped with sterile ultrasound gel in order to minimize interference and facilitate movement of the external electrode.

The subcutaneous tissue between the two probes is heated accordingly. The treated tissue tends to be hotter at the tip of the probe and recedes in temperature as it approaches the handle.

The depth of the internal probe is controlled by a wheel on the device that increases or decreases the distance between the two electrodes giving it a caliper-like appearance. The larger the distance between the two electrodes the larger amount of tissue is "sandwiched" between them resulting in a larger area heated.

The process of heating the tissues begins deep just like in liposuction. The difference being though, that instead of "debulking" the operator is heating. The movement of the probe is identical to the stroke of a liposuction cannula. In other words, deliberate and methodical with care not to spend too much time in one area. As heating progresses and the operator begins to treat the more superficial tissue he or she will be adjusting the wheel to close the distance between the two probes. As the surgeon approaches the dermis the distance between the electrodes is shortened even more in order to address the more superficial layers of the treated area. At no point does the internal probe come into contact with the under surface of the dermis or the subdermal plexus of nerves and vessels.

In conclusion the RF handpiece coagulates the adipose and connective tissue as well as the deep vasculature via the internal probe. The heating of the dermis occurs internally just below the external probe. The heating of the treated tissue block is homogenous and uniform (▶Fig. 10.3). Once the target temperature of 38–42°C is achieved the operator maintains the heat in that area for 1–3 min for optimal results.

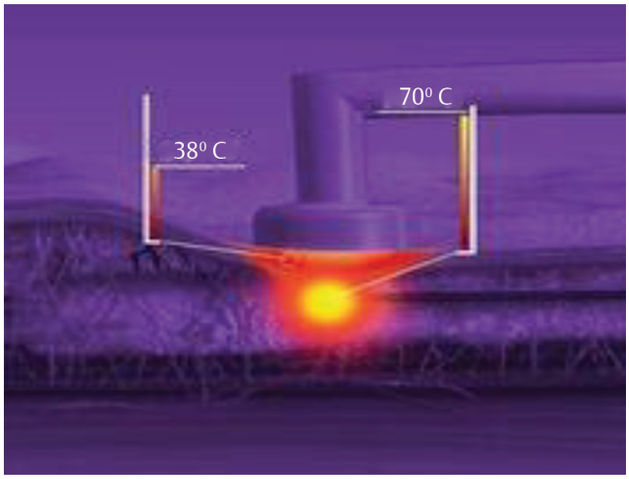

Fig. 10.3 The RFAL device Bodytite with two electrodes showing differential heating of the internal and external probe. The internal probe targets adipose, connective tissue, and the deep vasculature. The external probe heats the dermis.

The operator can then switch to a standard suction-assisted lipectomy (SAL) or power-assisted liposuction device (MicroAire, Charlottesville, VA, USA) to address the contouring aspect of the operation and bring the case to conclusion.

10.4 Safety Parameters

- The bodytite device has an audible bell that serves the purpose of warning the operator of the impending target goal temperature. As the target temperature of 38–42°C is reached, the bell sound intervals become shorter in duration warning the operator of the impending endpoint. This has the advantage of allowing the surgeon to focus on the operating field without needing to look at the LED screen for target temperature verification.
- The bodytite handpiece's internal probe has an infra-red thermistor which shuts down the energy output if the temperature exceeds predetermined parameters set before the onset of the case. For example the internal probe temperature can be set between 50–70°C and the external at 40°C depending on what the operator seeks to achieve.
- The teflon coated tip of the internal probe helps avoid end hit damage that can occur with any energy generating device in liposuction. However, the operator should be cognizant of this and avoid contact with the dermis by knowing where the tip is at all times (▶Fig. 10.4).
- Any device that uses energy has the potential to cause peri-portal burns to the skin. Liberal application of petroleum-based ointment by the operator to the portal site in addition to constant movement of the bodytite handpiece can prevent this sort of injury from occurring. In addition the teflon coating of the internal probe protects the surrounding access point on the skin.
- Do not spend more time than 1–3 minutes in a given area once target temperature is achieved. Slow and continuous application of heat results in even heating of tissues resulting in a uniform result. Tissue response and patient tolerance are thus achieved[6] (▶Fig. 10.5).

Fig. 10.4 The Bodytite external probe (shown), should remain in contact with the skin so that the internal probe (below the skin) remains deep enough to avoid burns to the skin. This device has other built in safeguards including a teflon coated tip to avoid end hit damage and potential burns to the skin.

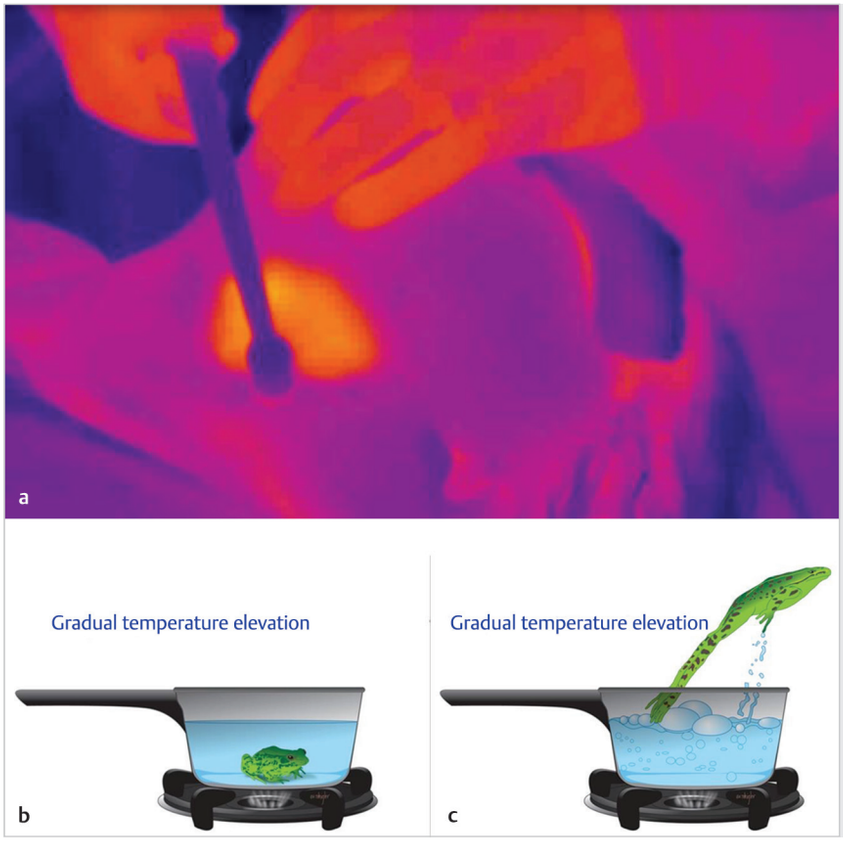

Fig. 10.5 These diagrams are an analogy for tissue response to higher energy settings (70 W and 38–42°C) used in previous studies with the radio frequency-assisted liposuction (RFAL) device and to the lower energy settings (35–40 W and 38–42°C) **(a)**. In our experience, both patient tolerance and tissue response to the energy delivered by the RFAL device are better at the lower energy settings as long as the same target temperature of 38–42°C is achieved. For tissue response to energy settings we use the analogy of a frog gradually being heated in a pot of water to a target temperature of 100°C (**b**) as opposed to the frog being placed in a pot of boiling water **(c)**. In the first instance, the frog (tissue response) tolerates the gradual increase in temperature and remains in the pot. In the second instance, the frog (tissue response) jumps out.

10.5 RFAL: Patient Selection

RFAL liposuction is ideal for a number of different scenarios. It should not be viewed as a substitute for traditional liposuction. Instead it fills a treatment efficacy gap where current technologies and methodology are lacking in their ability to contract skin. Refer to sections 10.5.1 and 10.5.2 for such examples.

10.5.1 RFAL Candidates

- Patients that are poor candidates for liposuction and not bad enough for an excisional procedure. This is a very large sub category of patients that have been turned down in the past for lack of effective treatment solutions (▶ Fig. 10.6a–h).

Fig. 10.6 A 30-year-old female. 35 watts 38°T. 2.7 LT. 48.8 KJ. 1 year. **(a, c, e, g)** Preoperative. **(b, d, f, h)** Postoperative.

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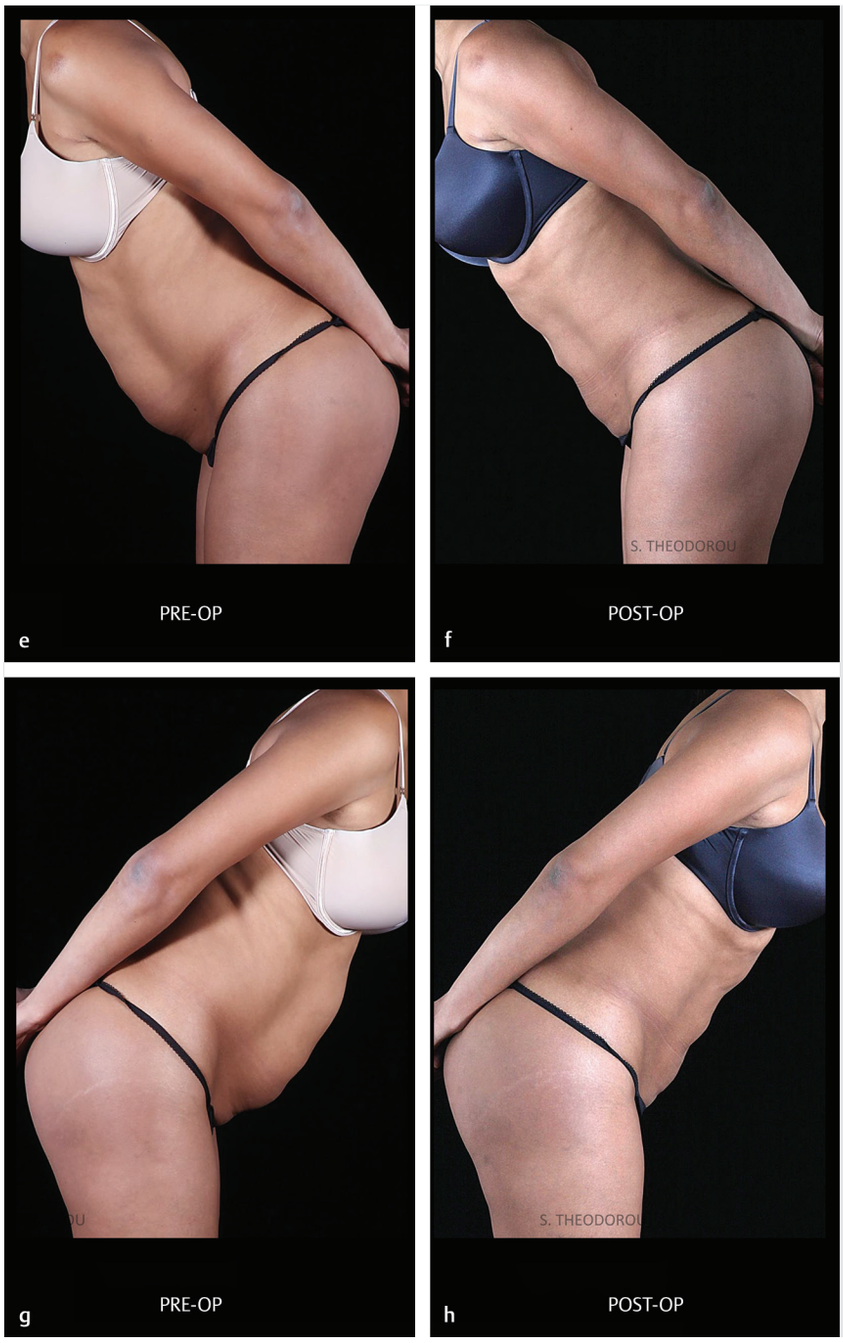

Fig. 10.6 (*Continued*) A 30-year-old female. 35 watts 38°T. 2.7 LT. 48.8 KJ. 1 year. (**a, c, e, g**) Preoperative. (**b, d, f, h**) Postoperative.

- Areas of non-adherence such as the arms. There is a very large number of patients with complaints of arm lipodystrophy and laxity that do not proceed with a brachioplasty operation due to the nature and the length of the scar.
- Medial thighs are good candidates for RFAL. This area is notorious for a high number of post-liposuction iatrogenic deformities. This occurs most commonly due to contour deformities related to laxity in this area.

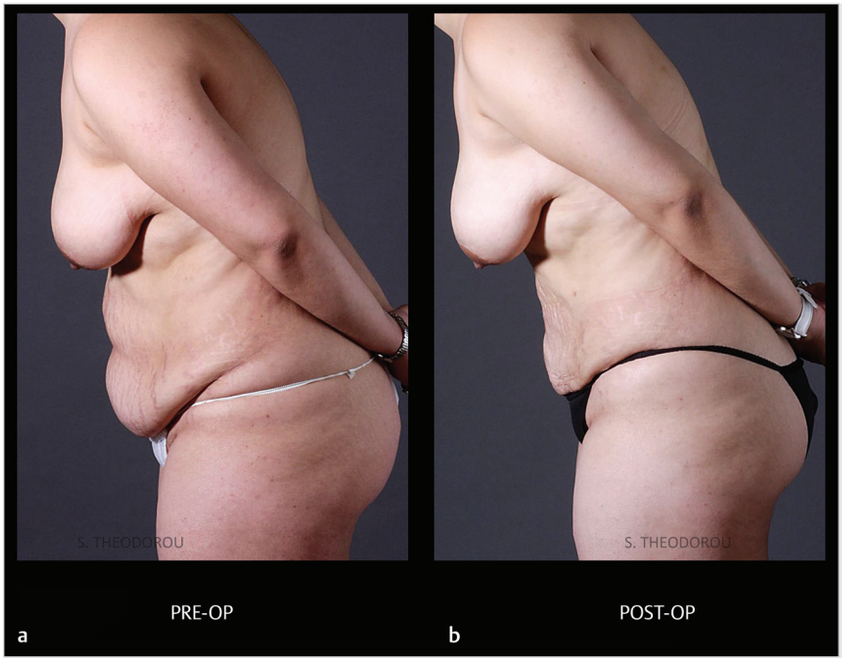

Fig. 10.7 A 32-year-old female. 40 watts 40°T. 1.15LT. 53.1 KJ. 18 months. **(a)** Preoperative. **(b)** Postoperative.

- Female patients that have had children but are not candidates for an abdominoplasty due to minimal or moderate laxity of the skin and lack of a significant rectus diastasis. The laxity tends to occur mostly in the infa-umbilical area where the majority of the growth of the uterus occurs during pregnancy (▶Fig. 10.7).
- Neck Laxity: Example such as middle age males not bad enough for a neck lift and not good candidates for liposuction (▶Fig. 10.8a–h).

10.5.2 Poor RFAL Candidates

- Patients that are candidates for excisional procedures.
- Massive weight loss patients. The dermis is typically irreversibly damaged in these patients and as a result does not contract well or evenly.
- Patients with no adiposity. RFAL requires an intact fibro septal network (FSN) with fat to work best. As an example massive weight loss patients with a 'deflated' appearance and thin adipose tissue respond poorly to RFAL.
- Supra-umbilical skin overhang with no adiposity with or without striae.
- Patients with Fitzpatrick I–II over 50 years of age tend to have a mediocre to poor response when performing RFAL on the body. Same age patients that are Fitzpatrick III–IV respond much better to RF energy as a result of a thicker and more contractile dermis.

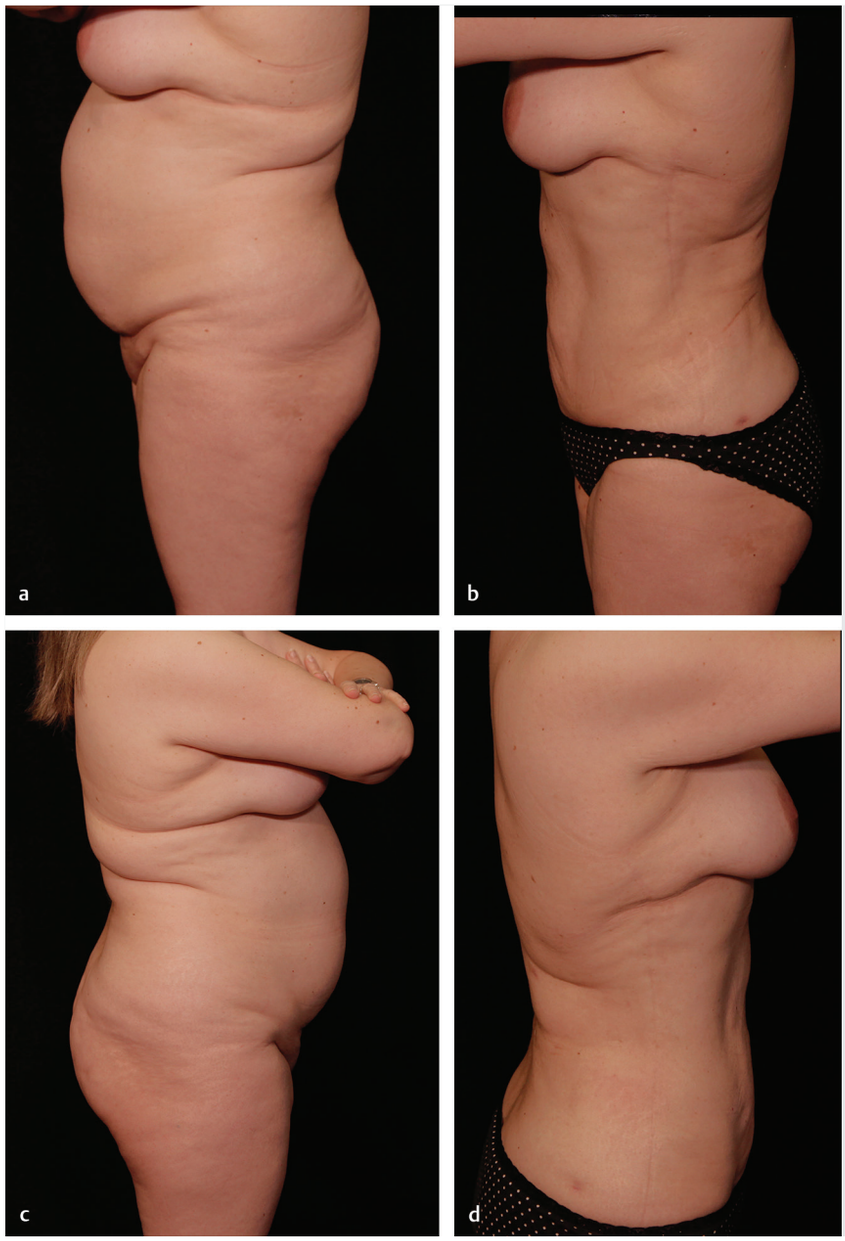

Fig. 10.8 (**a–d**) A 56-year-old female with Bodytite of the abdomen and flanks. 40 watts. Temperature 40.0°C and 70.0°C . 2019.

10.6 Pearls and Pitfalls

Pearls M!

- New treatment option that previously was not available to patients that are otherwise not candidates for liposuction due to skin laxity.
- RF technology is a great alternative to brachioplasty in many cases.
- RF allows surgeons to address laxity in the medial thighs more aggressively than previously possible since the RF energy will assist in the tightening (▶ Fig. 10.9).
- RF treats patient with neck laxity who are not candidates for neck or face lift.
- Abdominal laxity not bad enough for an abdominoplasty and ideal for liposuction (▶ Fig. 10.10).

Pitfalls

- Avoid Massive weight loss patients.
- Fitzpatrick I–II over 50 years of age.
- Avoid patients with striae.
- Thermal injury due to end hits and portal burns.
- Avoid patients that are candidates for excisional surgery.

Fig. 10.9 A depiction of the convexity of the lateral thigh treatment zone in relationship to the straight BodyTite handpiece. Caution needs to be exercised in the type of convex treatment area in order to avoid end hits (direct injury) and a rapid increase in temperature that can lead to possible full thickness injury of the dermis (indirect injury). The top picture points out the area of treatment and the lower depicts the magnified area of interest. The area in red is the zone of caution.

Fig. 10.10 A 41-year-old female. 70 watts 40°T. 3.5LT. 103.8 KJ. WL30 13 months. **(a)** Preoperative. **(b)** Postoperative.

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