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ORIGINAL ARTICLE

Treatment of Overweight Patients by Radiofrequency-Assisted Liposuction (RFAL) for Aesthetic Reshaping and Skin Tightening

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Abstract
Background Patients with massive volume or skin laxity typically are not ideal candidates for liposuction treatment due to the excess amounts of loose skin after the procedure. The feasibility, safety, and efficacy of a novel radiofrequency device (BodyTite system) for radiofrequency-assisted liposuction (RFAL) were prospectively evaluated with overweight and weight loss patients.
Methods In this study, 17 women with an average aspirated volume of 1,759 ml in the arms, abdomen, or thighs were treated. The treatment technique is described with the resulting weight, circumferential, and contraction measurements collected at a follow-up assessment after 6 and 12 weeks. Three-dimensional scanning was used to document volume changes in selected cases. Patient satisfaction also was recorded. Body contour and area tightening results were evident for all the patients, with high posttreatment satisfaction. Skin contraction was significant at 6 weeks and continued past 12 weeks of follow-up evaluation.
Results On the average, after 12 weeks, patients had lost 6.2% of their original abdominal circumference, 4.4% of their original thigh circumference, and 9.2% of their original arm circumference. The mean vertical contraction was 7.9% for the abdomen, 3.6% for the thighs, and 2.4% for the arms. The maximum results showed a circumference loss of 16.5% for the abdomen, 11.4% for the thighs, and 17.7% for the arms. The maximum vertical contraction was 15.7% for the abdomen, 7.4% for the thighs, and 3.3% for the arms. The average follow-up period was 13.3 months (range, 3–26 months).
Conclusion The RFAL approach is a viable means of energy-assisted liposuction for overweight and massive weight loss patients. Significant volumes of fat can be removed safely and effectively with improved contour and clinically significant skin tightening.

Keywords Radiofrequency · Liposuction · Skin tightening · Body contouring surgery

Liposuction is a minimally invasive procedure intended primarily for healthy, younger, relatively fit patients with firm elastic skin who are within 30% of their ideal weight [1]. Patients who are overweight or older than 50 years and those who have lost massive amounts of weight or exhibit some skin laxity are suboptimal candidates for traditional liposuction. After reduction of their excess adipose tissue, they are likely to have further skin laxity, which creates iatrogenic contour deformity.

For patients with considerably lax skin, the appropriate approach is excisional surgery such as abdominoplasty or brachioplasty, which is far more extensive than liposuction, leaving long scars, which for some are unacceptable. Moreover, for the overweight or obese patient, abdominoplasty carries an increased risk of delayed wound healing and complications. For borderline conditions or patients who desire a less extensive operation, safe liposuction with some reliable contraction of skin and subcutaneous tissue has been an elusive goal. Ultrasonic and laser energies have been adapted to address these issues for the body-contouring patient with mild deformity [2, 3].

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Most recently, the destructive energies of radiofrequency (RF) have been harnessed for liposuction, with some skin shrinkage [4]. This prospective clinical study applied controlled RF to oversized, mildly loose-skinned, and massive weight loss (MWL) patients. Individuals who do not qualify for RF-assisted liposuction (RFAL) include individuals with moderate to severely loose skin.

Methods

This report describes a subset of patients from one study site participating in pre–Food and Drug Administration (FDA) investigational trials examining the clinical application of RF-assisted lipoplasty using BodyTite by Invasix Ltd ((Invasix; Apolo Building, Tel Aviv, Israel). The inclusion criteria specified mild to moderate loose skin with excess fat of patients who were overweight, had sustained MWL, or had completed body-contouring surgery after MWL. The author reckoned that the patient would experience undesirable skin laxity after traditional liposuction.

The study was conducted under national institutional review board oversight (Essex Institutional Review Board, Inc, Lebanon, NJ; RAL 1, revised informed consent, May 7, 2009). Each patient was given a number (1 to 17) and identified by age, weight, body mass index (BMI), site of treatment, amount of fat aspirate, months of follow-up evaluation, complications, fat volume, and skin laxity before and after treatment rated on a scale of 1 as the least and 5 as the most change in circumference in terms of centimeters and comments. The comments were listed along with a numeric patient rating of results as 1 (no improvement), 2 (minimal improvement), 3 (worthwhile improvement), 4 (significant improvement), and 5 (optimal improvement).

Patient satisfaction was related to the subjective impression of the stability or reduction of skin laxity. Skin contraction was expressed as a percentage change between the before and after measurements of the trunk circumference times the vertical length of the anterior profile (Table 1).

Due to distinctly different clinical presentations, these overweight patients were subdivided into four groups: group 1 (age $\geq$ 50 years, BMI $\geq$ 27; patients 1–4), group 2 (age $\leq$ 40 years, BMI $\geq$ 27; patients 5–12), group 3 (MWL and body-contouring surgery with RFAL in areas that had no previous surgery; patients 13 and 14), and group 4 (MWL and body-contouring surgery with RFAL in areas that had previous surgery; patients 15–17). Selected patients were scanned using the Axis Three imager, (Axis Three, Boston, MA, USA) before and after their procedure, with recording of changes in volume and area.

Brief case histories with photographs are provided to demonstrate the aesthetic results in multiple views before and after the study for each of the four groups. This report provides an in-depth description of the treatment technique. The outcomes for the 17 women are tabulated in Table 1.

Men and women were recruited for the study. However, the one man who started the study did not return for his follow-up treatment.

Device

Patients were treated in the areas of the torso, arms, or thighs using the BodyTite RFAL device. The BodyTite's handpiece is affixed with two electrodes to provide subdermal heating and contraction. Radiofrequency energy is generated at a frequency of 1 MHz with a power range of 40 to 60 W. The RF current travels between electrodes coagulating adipose tissue and providing controlled heating of subcutaneous collagenous tissue. The internal electrode, performing as both an energy source and a 3.9-mm-diameter liposuction cannula, is inserted through a stab wound incision, and the 3-cm disc-like external electrode is applied to the skin's surface directly above the RF-emitting tip of the internal electrode (Fig. 1). During the procedure, the treatment depth, RF power, and skin temperature are controlled.

Anesthesia and Tumescent Infiltration

All the treatments were performed with the patient under oral sedation (Vicodin ES and Keflex 500 mg). Xanax (0.5–2 mg orally) and Toradol (60-mg injection) also were used in some cases. Patients sometimes reported intolerable heat in their treatment area, but their surface temperatures were not higher than those of patients who did not complain.

The typical superwet tumescent anesthesia used was induced by infusing 100 ml of 1% lidocaine plus 1 ml of 1:1,000 adrenaline in 1,000 ml of Ringer's lactate solution into the treated area through the incision until the tissues were turgid, with anticipation of removing 1 to 2 ml of fatty emulsion for every milliliter of infusion.

Ultrasound Gel

Sterile ultrasound gel (Aquasonic 100; Parker Laboratories, Inc, Fairfield, NJ, USA) was used to hydrate the skin's surface to ensure better RF conductivity and smoother movement of the external electrode.

Treatment Procedure

After attachment of the long electrical cord of the handpiece to the slender and light computerized rolling power generator, the BodyTite machine was turned on, and the

Table 1 Demographics, indications, and outcomes

Patient no.	Age (years)	Weight (kg)	BMI[a]	Excess fat and laxity	Total aspirate volume (ml)	F/U (mos)	Complication	Fat[b]	Lax[c]	Circumference[d]	Vertical reduction (%)	Area reduction (%)	Patient satisfaction (1–5) and comments[e]
1	57	68.5	27.6	Trunk	1,800	9	None	4/2	3/2	–8	–15.75	–32.81	5. A 5-lb weight gain, smoothed wrinkled skin
2	59	88.9	37	Abdomen	2,000	6	Some nodules	5/4	3/3	+2	–0.81	3.03	3. Gained 8 lb, which reduced satisfaction
3	57	77.1	27.4	Arms	1,200	22	Swelling	3/1	3/2	–5.5	–3.28	–39.93	4. Right arm oversuctioned, with depressed areas, BMI now 23.4
4	58	74.4	26.5	Arms	300	7	Skin burns	2/1	5/4	–1	–1.60	–7.95	2. BMI down to 23.1, arms still loose, resolving red burn scars
5	39	62.1	27.8	Trunk	1,300	26	None	4/2	3/2	–8	–6.12	–28.46	5. Early lumpiness resolved
6	39	68.0	27.4	Trunk	2,300	7	Seroma, catheterization	5/2	4/3	–4	–13.46	–23.16	4. No suction, mildly uneven, scattered nodules
7	39	61.2	27.2	Abdomen	1,350	8	Seroma, catheterization.	4/2	3/2	–7	–7.88	4.38	4. No suction, midabdominal bulge
8	22	77.1	31.1	Trunk	1,700	3	None	4/1	4/3	–8	–8.00	–53.00	2. Pregnant after 3 months
9	31	95.3	36.4	Trunk	3,400	8	None	5/3	3/3	–11	–3.00	–29.00	3. Weight gain. after study, had limited abdominoplasty/ RFAL
10	25	113.4	39.1	Abdomen	1,800	26	Induration	5/3	4/3	–5	–13.00	–17.00	4. Brief induration, measurements of 18 m taken before pregnancy
11	36	103.0	34.5	Arms	900	9	None	4/2	3/2	–2	–3.15	–19.78	4. Proximal sagging leading to limited skin resection
12	31	83.9	27.3	Thigh	5,600	24	Swelling	5/3	3/2	–8	–0.33	–23.36	4. Lymphopress 2 w, minor left contour irregularities
13	30	104.3	28.4	Arms	1,400	19	None	4/2	3/3	–4	–1.10	–18.43	5. Well sculptured with no laxity or contour irregularities
14	31	79.4	25.8	Arms	1,200	7	None	4/2	3/3	–3	–2.82	–20.45	4. Slightly overresected
15	42	56.2	24.5	Thighs	1,000	21	None	3/1	4/3	–4	–7.38	–7.38	4. Saddle bags and bulges corrected, no loose skin
16	40	63.5	24.8	Thighs knees	1,400	8	None	4/2	3/3	–2	–3.19	–6.74	4. Corrected lateral thigh and suprapatella fullness
17	48	77.1	29.1	Abdomen	750	16	Indurations	3/1	3/2	–8	–3.22	–18.94	4. Smaller abdomen without laxity, resolved tender midabdominal mass

Groups 1, 2, 3, and 4 are color coded. These overweight patients are divided into group 1 (≥50 years, BMI ≥ 27, patients 1–4), group 2 (≤40 years, BMI ≥ 27, patients 5–12), group 3 (massive weight loss [MWL] and body-contouring surgery [BCS] patients with RFAL in areas without previous surgery, patients 13–14), and group 4 (MWL and BCS with RFAL in areas without previous surgery (patients 15–17). Patients 1, 8, 9, and 10 correspond with Figs. 3, 4, 5, 6

BMI body mass index, *F/U* follow-up period, *RFAL* radiofrequency-assisted liposuction

[a] BMI body mass index at the time of RFAL

[b] Preoperative fat volume of 1 to 5 (increasing volume)/postoperative fat volume of 1 to 5

[c] Preoperative skin laxity of 1 to 5 (increasing laxity)/postoperative skin laxity volume 1 to 5

[d] Change in centimeters of circumference of the major treated area

[e] Satisfaction survey choice options: 1 (no change), 2 (small improvement), 3 (worthwhile improvement), 4 (excellent improvement), 5 (complete correction)

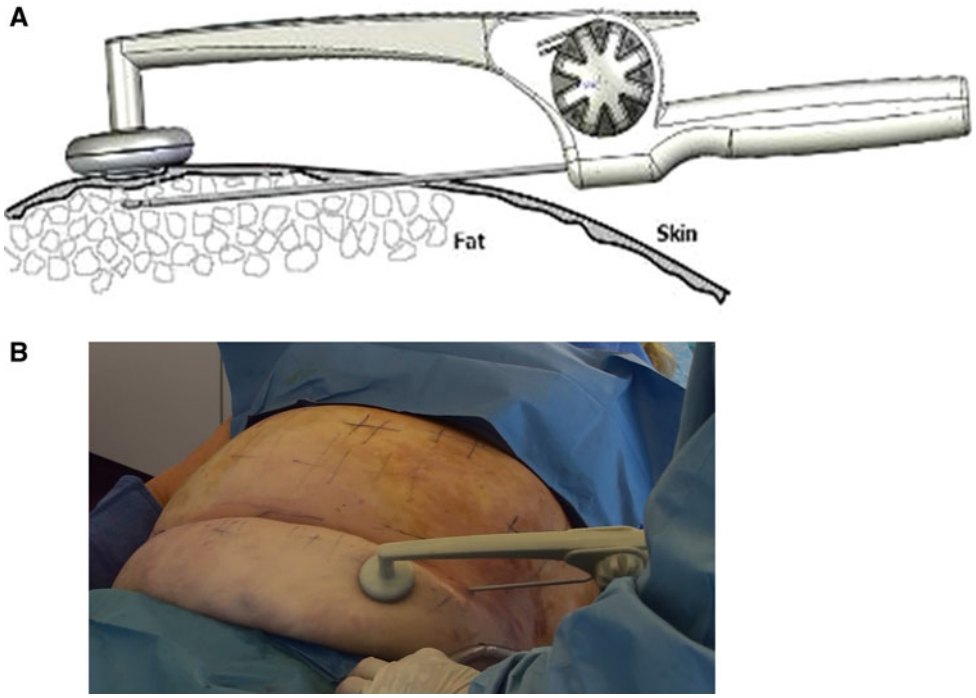

Fig. 1 BodyTite handpiece applied to the skin. **a** The internal electrode also is a hollow, blunt-nosed Mercedes configuration cannula. The radiofrequency current travels from the internal electrode cannula up to the external electrode and back, generating heat in the treatment zone, where the level of heat determines the treatment effect: contraction of collagen and fibrous septae as well as coagulation of fat and blood vessels. **b** The actual BodyTite handpiece in clinical use

predetermined limit settings for power in joules and skin temperature in degrees centigrade were made. A separate high-pressure suction system was attached to the end of the handpiece away from the energized probe tip through clear plastic tubing. A solid 2.5-mm-diameter probe was inserted through 3-mm incisions for the first eight cases, and then a probe with inline suction became available and was used for the last nine cases. Clear Teflon sheathing covered all but the distal 2 cm of these probes.

To counter the drag caused by the sheath, the RF energy was applied upon contact with fat. Within moments of passing the energized probe, the aspirated coagulated adipose tissue was seen in the vacuum tubing. In addition, it was noted that unlike the typical fanning motion used in suction assisted lipoplasty (SAL), the technique was modified to ensure that the cannula did not continually return to the same point, which can cause an overtreated zone and thermal buildup (Fig. 2). In addition, the movement of the RFAL handpiece was considerably slower than that for traditional liposuction, with a back-and-forth cycle spanning 3 to 6 s.

Initially, arresting resistance from fibrotic adipose was sometimes encountered, especially in younger patients, males, and with those who had undergone previous liposuction. In these situations, instead of increasing the mechanical force, we patiently let the RF energy disrupt and damage the restricting fibrous tissues so the cannula could glide smoothly through the tissue. The ideal end point at the deep adipose layer was the lack of mechanical resistance to the cannula movement through the adipose tissue. Generally, about 3 to 5 min were required to reach this result for each zone, and the skin temperature reached 34 to 36°C at this stage.

During planning, the treatment area was divided into zones averaging 10 × 15 cm in size, mostly resulting in division of the lower abdominal area into two zones and the upper abdomen into another two zones. This zone approach allowed easy access from one incision port and provided the best control of the skin temperature. An access port at least 3 to 4 cm from the treated area is recommended to avoid overtreatment of the area around the incision point.

In addition to zone size, another important consideration is the depth of treatment. The handpiece allows the surgeon to preset the treatment depth at 5 to 50 mm. All the patients were treated at two depths to address the deep and superficial layers of adipose tissues. In the torso and thighs, the deep layer was treated first at a depth of 25 to 40 mm (setting of 5 to 6 on the BodyTite handpiece) using the higher RF energies of 50 to 70 W.

It is important to note that using a higher power for the deep layer is not riskier than using a lower power due to the great distance between the cannula and the skin surface. The cutoff level was set at a surface temperature of 40°C allowable in the treatment area. This is a critical safety measure to ensure protection against thermal injury. During treatment, the system emits an audible double beep when the sensor is within 2°C of the cutoff temperature and a triple beep when the cutoff temperature has been reached.

During our treatment of the deep layer, the cutoff temperature was used only as a safety limit and not as an indication that the end point had been reached. After the

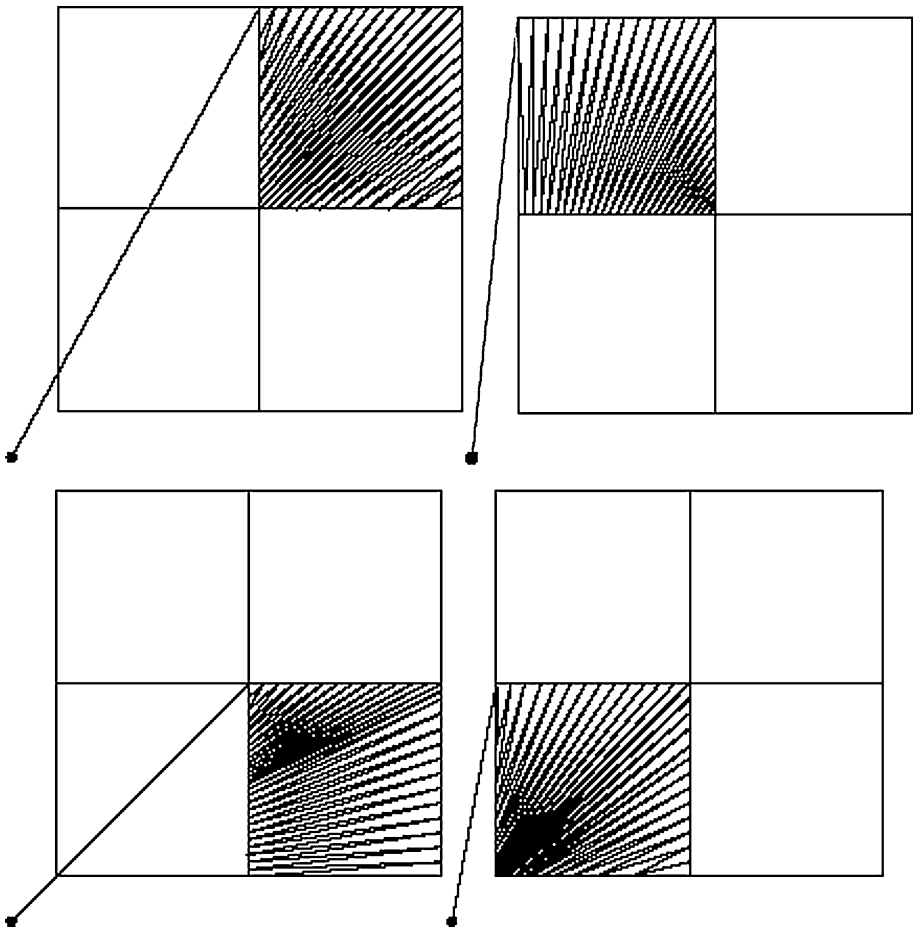

Fig. 2 Correct thermal zones and full area treatment. The sequence of thermal zone treatment furthest from the incision port is demonstrated first, followed by the nearest zone. The zigzag type of cannula movement back and forth via different routes also is shown. This movement prevents overheating while the same route is traversed twice or more

end point for the deep fat treatment had been reached, the superficial fat was treated. The depth of treatment was changed to between 10 and 15 mm by setting the handpiece to a level of 2 to 3. The cutoff temperature setting was left at the same level, but it now was an indication of the end point for the treatment of the superficial tissue.

A surface temperature not exceeding 40°C was chosen due to safety concerns. In the deep plane, the cutoff temperature usually was not reached but served as a safety margin. In the superficial plane, the cutoff temperature was the end point whereby significant contraction in a limited size area was apparent.

It required another 3 to 5 min to reach a uniform desired skin temperature. Depending on the goals, we could either move on to the next treatment zone or maintain the temperature in this area a few more minutes for additional tissue contraction. At this stage, it was critical to observe the skin's appearance. Erythema of the vasoconstricted area indicated a strong skin reaction to the heat and prompted discontinuation of treatment in that area. To prevent excessive heat from building, a cool wet towel can be applied to the pink surface. We observed that this heating effect was more typical for high-volume patients, with a large amount of heat accumulating in deep layers. When the desired skin temperature was reached and the appearance of the skin was appropriate, a contiguous treatment zone was approached.

For the final touches after all the treatment zones in an aesthetic region had been managed, we learned after the first 10 cases to suction emulsified and untreated fat as soon as RF treatment was completed for that region. Customarily, we used a 4-mm-diameter, three-holed, 30-cm-long traditional liposuction cannula to obtain a thinner and uniformly thick fat layer. Pinch and roll tests helped to confirm even fat distribution.

After the treatment, each incision port was closed with a single loosely tied polypropylene stitch and covered with small dressing. Compression foam was applied, followed by appropriate elastic garments. Patients were sat up and recovered in a separate observation room and then released to home when stable and alert. Early pain was not a problem due to xylocaine infusion.

The compression foam was removed 5 to 7 days later, and the patients then were allowed to shower. Their elastic garments were used for another 3 weeks to ensure proper healing and tissue positioning. We were pleased with the even and long-lasting compression provided by Marena garments (The Marena Group, Inc, Lawrenceville, GA,

Fig. 3 In group 1, a 57-year-old woman with a body mass index (BMI) of 27.6 kg/m^2 who had excess fat and loose skin localized to the abdomen desired fat reduction and skin tightening for her abdomen, thighs, and left flank. The patient was marked with approximately 10 to 15 cm in diameter zones on the abdomen and left flank for the area and magnitude of radiofrequency (RF) application. The distance between the electrodes varied from levels 6 to 3 on the handle setting, with the corresponding RF energy at 50 to 40 W from deep to superficial. The skin temperature was monitored throughout the procedure, reaching a high of 36.7°C, which was maintained for several minutes. The abdomen was treated with RF lengths of 4 min for the right upper quadrant (RUQ), 14 min for the right left quadrant (RLQ), 10 min for the left lower quadrant (LLQ), 5 min for the left upper quadrant (LUQ), and 4 min for the left (L) flank. A traditional 4-mm, three-holed suction cannula then was used to remove 400 ml from the epigastric area, 1,200 ml from the lower and middle abdomen, and 200 ml from the left hip, for a total of 1,800 ml. In addition, 100 ml was removed from the right medial thigh and 100 ml from the left medial thigh. Suction continued until a smooth and symmetric result was obtained. The total energy used was 78.9 kJ. The abdominal loose adiposity was corrected 6 months later, with some diffuse mild wrinkling of the skin

USA), which improved patient compliance. After the obligatory 6- and 12-week appointments of the protocol, additional examinations were performed to document longer-term results in terms of circumferential measurements, weight, and photography, including three-dimensional (3D) scans, up to the submission of this report.

Fig. 4 In group 2, a 39-year-old woman with a body mass index (BMI) of 25.3 kg/m^2 desired reduction of her enlarged central abdomen. Her radiofrequency (RF) energy was 50 to 40 W from deep to superficial. The skin temperature was monitored throughout, reaching a high of 38°C, which was maintained for several minutes. All quadrants on the first side were exposed to RF energy. Radiofrequency was applied to the right upper quadrant (RUQ) of the abdomen for 9 min, to the right lower quadrant (RLQ) of the abdomen for 14 min, to the right (R) flank for 5 min, to the lower left quadrant (LLQ) of the abdomen for 11 min, to the left upper quadrant (LUQ) of the abdomen for 5 min, and to the (L) flank for 5 min. Cannula suctioning then was performed with removal of 450 ml from the right abdomen, 200 ml from the right flank, 450 ml from the left abdomen, and 200 ml from the left flank, for a total of 1,300 ml from the abdomen and flanks. The total energy used was 84.1 J/km. The result is seen here 10 months later as correction of the loose midabdominal excess fat but no skin laxity or nodularity

Results

The demographics and outcomes for the 17 women who were overweight or had MWL are tabulated in Table 1. The average follow-up period was 13.3 months (range, 3–26 months). Surgeon observation and patient assessment in most cases showed substantial reduction in skin laxity, with improved contour and appearance of the skin after treatment. Although the 17 patients were subdivided into groups and treated in different body areas, the mechanism

Fig. 5 A 31-year-old woman in group 3 had a body mass index (BMI) of 28.4 kg/m^2. She had lost 100 lb after gastric bypass. The level of the electrodes varied from settings of 3 to 1 on the handle. The skin temperature was monitored throughout, reaching a high of 40.7°, which was maintained for 2 min. The first side was exposed to radiofrequency (RF) energy, and then cannula suctioning was performed, with removal of 700 ml from the right arm. The same was done to the left arm, for a total of 1,400 ml. The result 6 months later is seen here as reduced contours and no laxity

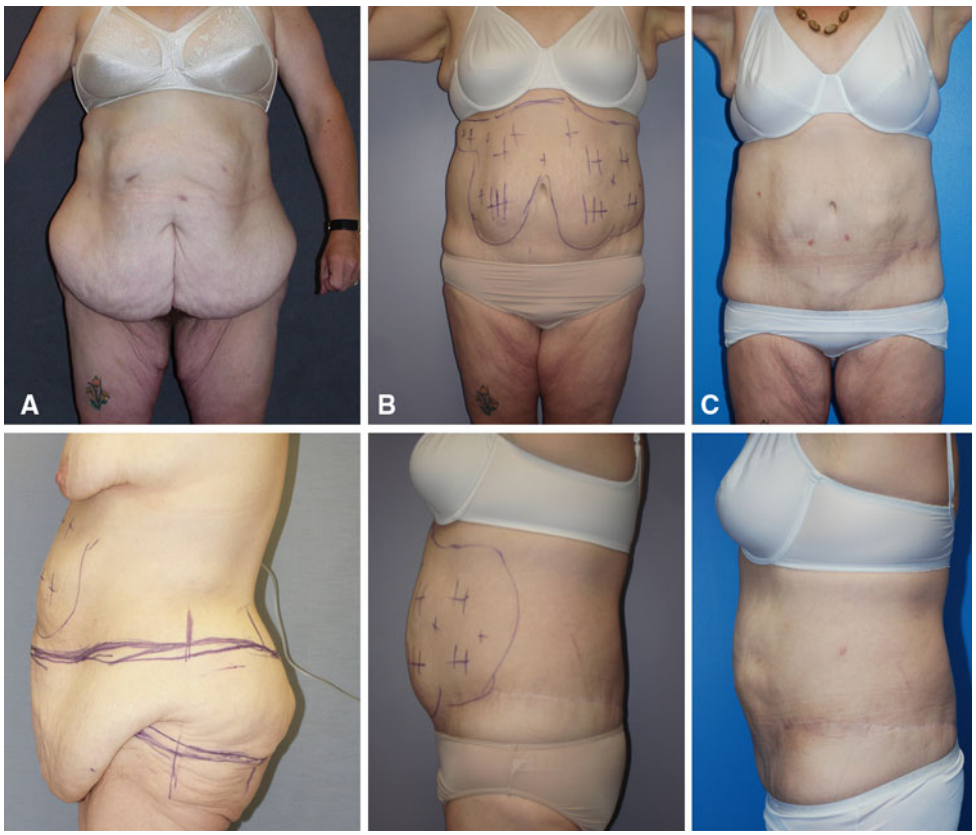

Fig. 6 In group 4, a 5-ft 4-in. 170-lb massive weight loss patient had an abdominoplasty in 2002. The plus markings for her abdominal radiofrequency-assisted liposuction (RFAL) are seen. The infiltrate was infused throughout the area to be treated until the tissues were turgid, for a total of 1,000 ml. The premarked areas were subdivided into approximately 10-cm quadrants, and through the 3-mm incisions, the Teflon-coated arm of the handpiece was coursed back and forth through the fatty tissues with the width between the electrodes varying from settings of 5 to 2 on the handle. The skin temperature was monitored throughout, reaching a high of 36° to 40°. During the radiofrequency (RF) treatment, 200 ml of lipoaspirate was removed altogether. Then 550 ml was removed from the entire abdomen during suctioning. The total energy used was 139.2 kJ. The result 4 months after the RFAL here shows correction of the loose adiposity with no skin laxity

of RFAL on fat anywhere was similar, and the results also are expressed in the same terms of circumference reduction and skin contraction.

Histologic reviews provided evidence of change in the connective tissue structure accomplished by coagulation of deep, reticular, and dermal collagen, leading to 3D soft tissue

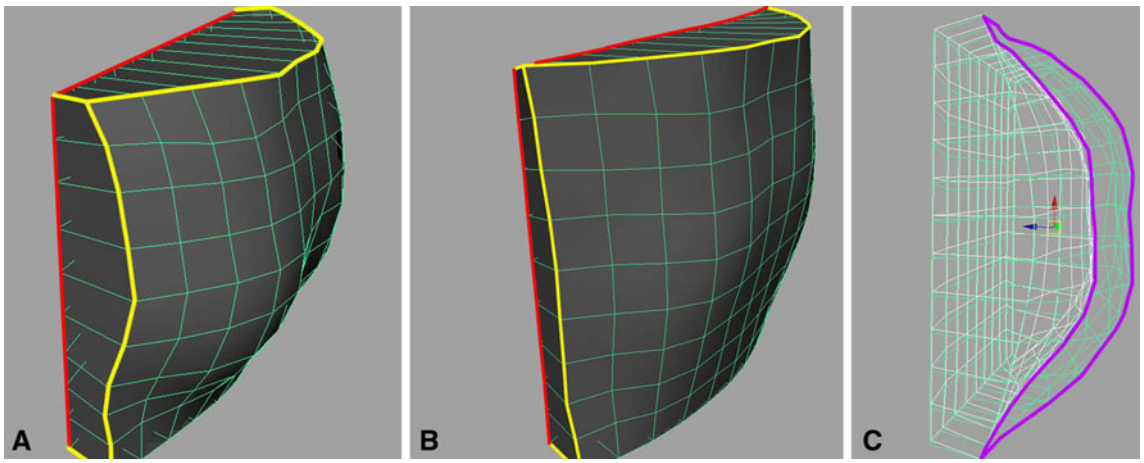

Fig. 7 A three-dimensional (3D) scan and analysis of the patient in Fig. 6. Preoperative (**a**) and postoperative (**b**) volumes in red outline the simulated abdominal wall, with yellow outlining other defining boundaries of volumes measured. Parts B and C are worms-eye views of the preoperative mesh (*green*) superimposed on the postoperative mesh (*white*). *Bottom:* Same as the top, with the volume difference (27.9%) outlined in purple

contraction and contours [5]. Examination of patients at 6 and 12 weeks showed a steady but slight improvement in skin tightening, which persisted until the last examination 3 to 24 months later (average, 13.3 months) for the 17 patients.

A photographic example of each group is presented in Figs. 3, 4, 5, 6. In group 1 (older overweight patients), surface contraction clearly occurred, but resolution of skin wrinkling and irregularities was incomplete (Fig. 3). The four older group 1 patients had an average BMI of 29.62 kg/m^2. One group 1 patient with an 8-cm trunk circumferential reduction was optimally satisfied, giving a rating of 5, whereas another group 1 patient, whose BMI dropped to 23.4 kg/m^2, had excessively loose arm skin, leading to a disappointment rating of 2.

In group 2 (younger patients), shrinkage also occurred, but the wrinkling resolved with minimal irregularities (Fig. 4). The group 2 young patients had an average BMI of 31.04 kg/m^2. One group 2 patient with an 8-cm circumferential trunk reduction offered a rating of 5, whereas another became pregnant and claimed a rating of 2 due to her persistent weight gain.

Group 3 (weight loss patients) had very good responses with RFAL performed in regions that had no surgery (Fig. 5). Group 3 patients had an average BMI of 27.1 kg/m^2. Group 4 patients also showed remarkable volume reduction, with no further skin laxity for RFAL in regions previously treated with surgery. Group 4 had an average BMI of 26.1 kg/m^2. All the patients in these two MWL groups had significant improvement and were pleased with their results, indicating that MWL patients did well with RFAL.

Selected patients were scanned pre- and postoperatively for 3D analysis using the Axis Three imager. Measured suction output reflected quantifiable volume, which correlated directly with reduction in surface area without observable skin laxity (see Fig. 7 for an example). Due to technical difficulties, only selected patients went through the Axis Three imager. They were representative patients from all four groups.

The average BMI was 29.47 kg/m^2 for the entire population of 17 patients. In general, after 6 weeks, the reshaping was mostly completed, but wrinkled skin was possible, and there were occasional subcutaneous lumps. Patients felt numbness and a firm sensation in treated areas, with scattered areas of tenderness. Edema and bruising had disappeared.

After 12 weeks, seven of nine abdomen patients demonstrated circumferential reduction. On the average, patients lost 6.2% (6.7 cm) (range, –11.9% to +5.7%) of their original abdominal circumference. These patients lost 2.8% (1.63 kg) of their original weight on the average, with three patients demonstrating weight loss exceeding 4.54 kg.

Patients who demonstrated less abdominal adipose tissue sagging before abdominal RFAL had some persistence of sagging skin after treatment. On the average, after 12 weeks, patients had lost 6.2% of their original abdominal circumference, 4.4% of their original thigh circumference, and 9.2% of their original arm circumference. The mean vertical contraction was 7.9% for the abdomen, 3.6% for the thighs, and 2.4% for the arms. The maximum results show a circumference loss of 16.5% for the abdomen, 11.4% for the thighs, and 17.7% for the arms. The maximum vertical contraction was 15.7% for the abdomen, 7.4% for the thighs, and 3.3% for the arms.

Three patients treated in the thighs represented an average circumferential reduction of 4.4% (1.50 kg). One patient experienced weight gain but still recorded a 1.7% circumferential reduction. All patients experienced substantial removal of excess fat, with no change or even reduced laxity. Minor contour irregularities were present in

every case and difficult to prevent but were diminished with experience.

All five patients with treatment of the arms demonstrated circumferential reduction 12 weeks after treatment. On the average, patients lost 8.6% (3 cm) (range, –17.7% to –3.1%). The best candidates appeared to have 300 to 500 ml of excess fat, with mild to moderate laxity. Patient 13 in Fig. 5 lost 90 lb and had a mastopexy before RFAL of her oversized and sagging arms. Each mid-arm circumference was reduced an average of 3.5 cm.

With RF-assisted lipoplasty, the treatment of large-volume patients is accompanied by coagulation of a large volume of adipose tissue. The RF power used depends on the fat thickness and treatment plane and not on the anatomic area. The deeper the treatment, the higher the power because the distance from the skin surface is sufficient. We found that treating at a depth of 30 to 50 mm enables the use of 50 to 70 W, whereas superficial treatment at a depth of 15 to 20 mm restricts the power to between 30 and 40 W.

The therapeutic index is narrow, and minor adverse effects are common. A seroma requiring an indwelling catheter for 1 week was necessary for one patient, which probably was the result of overtreatment without inline aspiration. Prolonged retention of hot emulsified fat is be avoided by the use of inline suction during application of RF energy and follow-up traditional liposuction as soon afterward as practical. Patients should be observed for this potential side effect during the first 4 weeks, and drainage of the coagulum will resolve the problem.

Four patients had transient focal areas of induration. Massage and low-level laser treatments expedited resolution of early induration. During the first 6 weeks, there usually was progressive wrinkling of the skin, which was fading by 12 weeks. This probably was due to contracture of the subcutaneous tissue beyond the shrinkage of the overlying skin.

Discussion

In properly selected overweight and weight loss patients, RFAL removes unwanted fat and provides clinically relevant shrinkage of the skin. Because RFAL results in volume reduction without loose folds in any of these patients, there must be 3D skin and vertical subcutaneous contraction. Care must be taken not to over-reduce the volume because undesirable depressions may occur, as in the arms of patient 3. The optimal patient appears to have excess adipose with mild to moderate skin laxity and is adverse to the usual length of scars associated with excisional surgery.

Severe skin laxity should not be treated with RFAL. The older overweight patients of group 1 experienced good shrinkage of surface area but had persistent wrinkled skin.

After body-contouring surgery for MWL, RFAL appears to be an excellent method for minor touch up of oversized areas. Nevertheless, we believe the sample size was too small for a statistical review in this pilot study.

At the last postoperative visit, all the patients were asked to rate their volume loss and skin retraction results on a scale of 1 through 5, with 5 denoting that their expectations were met or exceeded. Because all the patients knew the objectives of this experimental protocol and anticipated this question, we believe the responses, although subjective, were accurate and worthwhile. Unless they experienced considerable weight gain or loss, these patients were satisfied with the improvement (Table 1).

Other forms of energy-emitting lipoplasty using ultrasound and laser exist. The author has extensive experience with ultrasound-assisted lipoplasty and has found a variable amount of skin contraction after the procedure. We believe that tissue contraction in ultrasound-assisted lipoplasty has more to do with the selective removal of fat than with the direct thermal injury caused by the ultrasound. Certainly, overexposure to ultrasound energy can result is severe scarring with prolonged thickening of the tissues. Laser-assisted lipoplasty is reported to contract the tissues, with newly available wavelengths having some advantage over the first-generation systems. The initial data indicated that laser-assisted lipoplasty did not offer advantages over standard assisted liposuction [6]. However, recent upgrades in platform designs and wavelength configurations claim a smoother result with better skin contraction [2]. Nevertheless, a limitation still exists in that laser-assisted treatments are time consuming, with optimal results shown for small treatment areas.

Conclusion

The RFAL treatment combines a liposuction procedure with volumetric heating of the subcutaneous tissue, creating a contraction of the skin and subcutaneous tissue. In this small series of overweight patients with lax skin, a clinically significant tightening effect accompanied the fat reduction. BodyTite allows surgeons to replace a portion of their excisional surgery with a new minimally invasive procedure that tightens skin during volume reduction to the satisfaction of overweight patients.

Disclosure Dr. Hurwitz is involved in a clinical trial with BodyTite by Invasix and has received use of the BodyTite system as well as financial payment for services as the treating surgeon.

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