

# The Efficacy and Safety of Subcutaneous Radiofrequency After Liposuction: A New Application for Face and Neck Skin Tightening

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### Abstract

**Background:** Minimally invasive or noninvasive skin-tightening procedures have become trends in facial and neck rejuvenation. Radiofrequency-assisted liposuction (RFAL) is a new choice for the treatment of skin relaxation that is more effective than noninvasive surgery without surgical incision.

**Objectives:** The authors recommend a 2-step method in which radiofrequency is applied after appropriate liposuction is performed. This approach is safer and more effective than traditional RFAL, and the authors detail the safety guidelines, operative techniques, postoperative satisfaction results, and complications.

**Methods:** A total of 227 patients with lower face and neck skin laxity underwent RFAL between April 2012 and June 2019. The following data were collected: age, body mass index, operative duration, volume of fat aspirated, amount of energy delivered, and number and type of complications. Patient satisfaction was surveyed postoperatively and assessed by third-party surgeons at 3 and 6 months.

**Results:** At 6 months after operation, 78.8% of patients considered the results moderate to excellent, whereas 21.2% of the patients considered the results to be poor or thought there was no change. The photograph evaluation performed by independent plastic surgeons showed moderate to excellent results in 89.1% of patients. There were no major complications that required further medical or surgical intervention.

**Conclusions:** This 2-step method is a safe and effective improvement in the application of radiofrequency for face and neck skin tightening. Patients can achieve significant contour correction via minimally invasive surgery with a lower risk of side effects.

### Level of Evidence: 4

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Less invasive, nonexcisional skin-tightening procedures with minimal scarring have become trends in facial and neck rejuvenation. Excisional facial surgery, such as multifarious rhytidectomy, may provide dramatic improvement; unfortunately, the long scar, lengthy recovery, and associated morbidity and numbness significantly limit the popularity of these procedures, especially among Asians and other populations with dark skin. Noninvasive procedures, such as treatments based on radiofrequency (RF), laser light, infrared light, or high-frequency focused ultrasound, have greater acceptance, but the aesthetic outcomes are relatively modest compared with those of excisional surgeries.<sup>1-3</sup>

Radiofrequency-assisted liposuction (RFAL) is a recent technique in which RF energy is applied to liquefy the adipose tissue for liposuction and stimulate collagen formation and contraction via thermal effects.<sup>4-6</sup> BodyTite (Invasix, Yokneam, Israel) was first introduced in 2009 for body contouring and skin tightening<sup>7</sup>; it is an RFAL device that has shown the capability for significant contraction through a minimally invasive procedure. Skin tightening by RFAL is due to its effect on collagen in the dermal and subdermal fibro-septal network (FSN) tissues.<sup>6</sup> Beginning in 2012, our team started to use BodyTite in face and neck skin-tightening procedures. It is recommended that high-energy RF be directly applied to the subcutaneous layer without prior liposuction; however, we recommend first finishing moderate liposuction and then applying RF, which we call the 2-step method, for 3 reasons:

1. The 2-step method can initially create working channels by liposuction, which enables RF to be applied more easily and accurately.
2. Moderate liposuction can expose the subdermal FSN tissue, allowing the RF energy to directly affect the collagen of the FSN and increasing the extent of contraction. Fewer complications occur as a result of applying less energy after first removing fat tissue.
3. Asians prefer to have v-shaped faces; the 2-step method can provide better contouring of the facial curve through fat tissue reduction combined with facial skin tightening (Figure 1).

In this article, we illustrate our experience with this 2-step method and detail the safety guidelines, operative techniques, and complications.

## METHODS

### Study Design

A total of 227 patients aged from 26 to 61 years with lower face and neck skin laxity were enrolled in this study. The patients underwent treatment with the 2-step method

between April 2012 and June 2019. All procedures were performed by 2 experienced plastic surgeons (F.L. and X.H.). The authors complied with the principles of the Declaration of Helsinki. All participants provided written informed consent.

The inclusion criterion was mild to moderate skin laxity of the face and neck. The exclusion criteria were as follows: pregnancy or breast-feeding, severe skin laxity, significant chronic illness, severe platysmal banding, presence of a pacemaker or internal defibrillator, recent surgery within 3 months in the treatment area, and inability to complete all postoperative appointments.

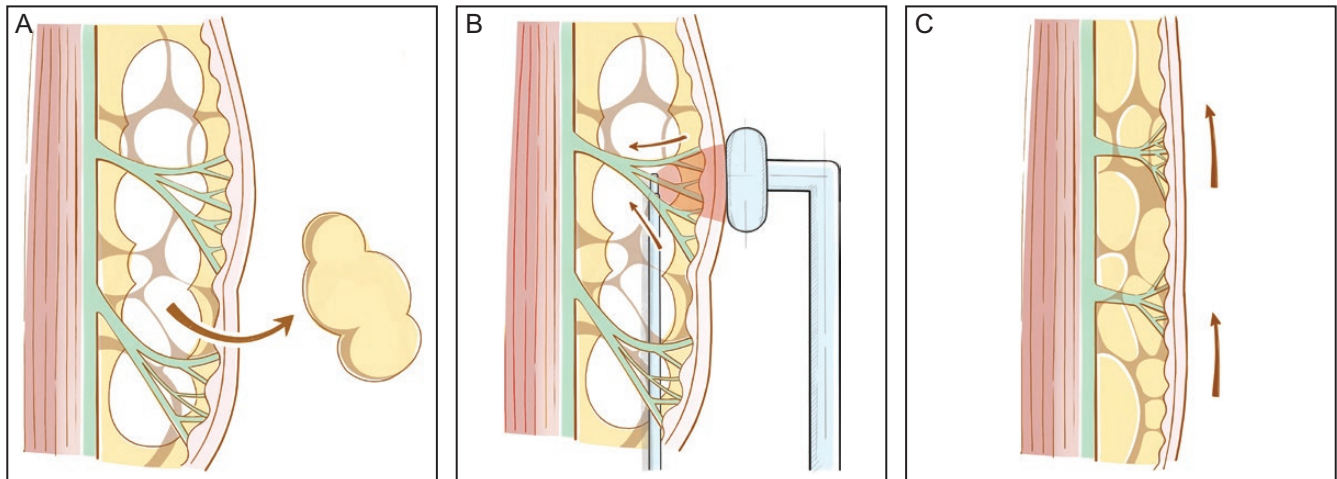
The following data were collected: age, body mass index, operative duration, volume of fat aspirated, amount of energy delivered, and number and type of complications. For this protocol, all patients were asked to return to our hospital at 3 months and 6 months after surgery. Standard photographs were taken before and at each follow-up visit after surgery. Complications, such as seroma, hematoma, and skin necrosis, were documented during the study period.

### Devices

We used the BodyTite RF apparatus (Invasix, Ltd., Yokneam, Israel) for skin tightening, which can deliver energy to trigger the immediate and extended contraction of dermal and subdermal collagen. The BodyTite system is composed of a bipolar RF hand-piece and a computer device. The special FaceTite hand-piece, which is 10 cm in length and 1.7 mm in diameter, was utilized in our procedures. The internal electrode is coated with Teflon, and RF is emitted only from the tip; the external electrode receives RF and closes the current loop. Above that, the external electrode also has an embedded thermal surveillant sensor, which can turn off the RF to prevent excessive heating, allowing the surgeons to maintain a consistent therapy and minimize the risk of thermal injury.

### Surgical Steps

Before procedures, all patients were adequately marked in the standing position. All operations were carried out with the patients under intravenous sedation. This procedure can be conducted with local anaesthesia only, and we recommend increasing the concentration of lidocaine to 0.06%. The tumescent solution was composed of 400 mg of lidocaine and 1 mg of epinephrine per liter of normal saline. A 14-gauge needle was utilized for creating the puncture incisions; then, the tumescent solution was injected into the subcutaneous plane until appropriate turgor was achieved. Approximately 80 to 120 mL of solution was employed in the lower face, and another 80 to 120 mL was



**Figure 1.** The fibro-septal network tissue is in a relaxed state after the load of fat tissue is reduced (A), allowing a more significant contraction effect to be achieved through radiofrequency treatment (B). As the fibro-septal network tissue is drawn together, the subdermal septal and fascial tissue changes positions, resulting in a facelift effect (C).

utilized if the neck was treated. The main significance of the tumescent solution is to reduce bleeding, reduce post-operative pain, and expand the space between the skin and superficial musculoaponeurotic system (SMAS). On the other hand, the RF operation does not require fluid as a conductor, and excessive water may deplete RF energy. The procedure was performed through 3 puncture incisions: 1 behind each ear lobe for the lower face and 1 under the chin for the neck. We utilized a 1.6-mm blunt-tipped cannula for liposuction; it must be noted that when injecting the tumescent solution into the neck, the middle zone should be avoided by injecting with both lateral side at a time to prevent compression of the trachea.

Following liposuction, conservative settings are encouraged, as follows: a maximum power of 10 W and a maximum epidermal skin temperature of 39.0°C. It is very important to ensure that the internal electrode is placed on the SMAS to avoid potential injury to the facial nerve. The FaceTite handle can be employed in a repeated slide and stamp-like movement at the level created by liposuction; the FSN tissue contracts when the desired temperature is reached, and the RF energy is automatically cut off by the surveillance sensor. All patients were instructed to wear compression garments continuously day and night for 5 days and at night only for an additional 2 weeks. The patients were followed regularly at 3 months and 6 months after the operation.

## Evaluation Method

Three independent plastic surgeons evaluated pre- and postoperative photos at 3 months and 6 months after the operation. They were asked to independently score

the improvement in skin laxity employing a 4-point scale method: 4 = excellent, 3 = good, 2 = moderate, and 1 = poor. The patients were asked to answer a patient questionnaire to grade their results and skin tightness at each postoperative follow-up visit (Appendix A).

## RESULTS

All patients successfully underwent treatment of the lower face and neck with the 2-step method, including 4 male patients and 223 female patients. The average follow-up time was 10.8 months (range, 6-60 months). The mean age of the patients was  $41.6 \pm 8.8$  years (range, 26-61 years). The mean body mass index was  $23.1 \pm 4.1$  kg/m<sup>2</sup> (range, 17.1-27.1 kg/m<sup>2</sup>), the mean volume of fat aspirated was  $12.6 \pm 4.5$  mL, the mean amount of energy delivered was  $4.0 \pm 1.6$  kJ, and the average operative duration was  $65.7 \pm 14.8$  minutes (Table 1). Most of the patients returned to work 5 days after the operation. At 6 months after the 2-step method, 78.8% of patients considered the results to be moderate to excellent, whereas 21.2% of the patients considered the results to be poor or thought that there was no change. The photographic evaluation performed by independent plastic surgeons showed moderate to excellent results in 89.1% of these cases and poor results in only 10.9% of cases (Table 2).

There were no major complications that required further medical or surgical intervention. Two patients developed hardness of the subcutaneous tissue after the operation, which was resolved at 1.5 months by massage. One patient developed a local facial skin depression after the operation, which was resolved by fat grafting at 3 months postoperatively. No patient experienced

**Table 1.** Patient's Treatment Summary

	Age, y	BMI, kg/m <sup>2</sup>	Fat aspirated, mL	Energy, kJ	Operative duration, min
Mean ± SD	41.6 ± 8.8	23.1 ± 4.1	12.6 ± 4.5	4.0 ± 1.6	65.7 ± 14.8

BMI, body mass index.

**Table 2.** Results of Patient and Physician Satisfaction Scores

	Patient				Doctor			
	Poor	Moderate	Good	Excellent	Poor	Moderate	Good	Excellent
3 months	23.8%	11.1%	20.3%	44.8%	18.7%	6.6%	24.5%	50.2%
6 months	21.2%	7.3%	15.8%	55.7%	10.2%	5.7%	27.4%	56.7%

At 3 months, moderate to excellent in 76.2% (patients) and 81.3% (independent plastic surgeon). At 6 months, moderate to excellent in 78.8% (patients) and 89.8% (independent plastic surgeon).

haematoma, infection, or seroma after treatment (Figure 2; Supplemental Figures 1-3).

## DISCUSSION

Although rhytidectomy remains an effective procedure for patients with severe facial and neck skin laxity, for patients with mild to moderate skin laxity, it is difficult to accept a long incision and the risk of various significant morbidities, leading both doctors and patients to seek other alternatives.

In addition, noninvasive skin-tightening devices, such as devices for delivering trans-epidermal RF, laser irradiation, or, recently, high-frequency focused ultrasound, have been employed in clinical settings for many years with variable results.<sup>8-12</sup> We know that the fascial tissue, which is composed of collagen, contracts on reaching 60°C to 80°C,<sup>13-19</sup> but skin surface temperatures above 43°C may result in the perception of pain in adult human skin and a delayed adipocyte cellular death response<sup>7,20,21</sup>; therefore, when noninvasive skin-tightening devices are applied, the dermal and subdermal temperature is significantly lower than the threshold for collagen contraction, and, accordingly, the effect is not satisfactory.

RFAL devices, such as the BodyTite system, have been widely applied in recent years, and research teams from various countries have confirmed their promising skin-tightening effect.<sup>22</sup> DiBernardo reported a 10.6% skin surface area reduction obtained by suction-assisted lipoplasty alone<sup>2</sup> compared with a recent randomized, blinded study that showed 35% soft tissue contraction at 12 months by RFAL.<sup>5</sup> The surface area reduction in the RF-treated patients can be attributed to the heat applied to the collagen in dermis and the FSN in the subdermis. We have been utilizing this technology since 2012 by combining

traditional tumescent liposuction and RF contraction techniques, which we called the 2-step method, and we have noticed that better results can be achieved with fewer complications.

The face and neck are anatomically complex areas for applying RF, so operations need to be performed in a very gentle manner. Although there is a nonaspirating RF hand-piece specially designed for the face that can be employed directly without liposuction, we present our special strategy, the 2-step method, which allows doctors to focus on liposuction first to create smooth working channels and define the operative level; then, the surgeons can more confidently focus on the RF procedure, reducing the incidence of complications. The RF procedure takes approximately 10 to 20 minutes, which does not significantly prolong the operation time compared with liposuction alone. The potential operative risks of RFAL are greatly reduced, and the learning curve is no longer steep for operators.

In addition, appropriate liposuction in this 2-step method allows better exposure of the FSN. Reports show that an adequate adipose layer and underlying matrix affect the potential for skin contraction by RFAL.<sup>23</sup> Paul reported that the strongest contraction response was observed in patients with adipose tissue containing septal connective tissue and reticular collagen fibers encasing fat cells.<sup>3</sup> Duncan reported that excessive or uncontrolled thermal stimulation can increase the risk of seroma.<sup>5</sup> Because the skin is very thin and the subcutaneous FSN is not abundant in the face compared with the abdomen and extremities, it is a challenge to utilize less energy to obtain a better contraction effect.

In addition, after reducing the load of fat tissue, the FSN tissue is in a relaxed state, so a significant contraction effect will be produced by RF treatment. Moderate liposuction



**Figure 2.** (A, D, G) This 52-year-old female patient underwent 2-step radiofrequency treatment of the lower face and neck under tumescent anaesthesia combined with intravenous sedation. Images obtained at 3 (B, E, H) and 5 (C, F, I) years after the operation (this is the longest follow-up duration to date) showed good preservation of the tightening effect of the lower face and neck. FaceTite device: power, 10 W, temperature, 39.0°C; total energy delivered, 5.9 kJ; operative duration, 76 minutes; fat aspiration volume, 16.0 mL.

can not only reduce the load of fat tissue but also allow better exposure of the FSN; thus, the 2-step method can achieve a better skin-tightening effect with less energy and minimize the incidence of energy overdose-related complications, such as hematoma and seroma. Incidentally, there was a case of local facial skin depression after treatment,

suggesting that the 2-step method still has quite a strong effect in terms of septal and fascial tissue contraction, which serves as a reminder to be cautious in local treatment ([Supplemental Figure 3](#)).

We know that RF energy is emitted only between the 2 electrodes, and the facial nerve runs in the layer below

the SMAS, so this approach is relatively safe as long as the internal electrode is working above the SMAS. It should be noted that when inserting the inner electrode, the practitioner should try to stay close to the dermis to ensure that the electrode is above the SMAS. In addition, temperature monitoring occurs only on the external electrode, and it indirectly reflects the change in internal temperature. However, in the next-generation device, both internal and external electrodes have temperature monitoring. This makes it safer and easier for doctors to perform the operation.

Finally, Asians have an aesthetic preference for a v-shaped face (ie, the so-called “inverted triangle of youth”). Liposuction can better sculpt the curve of the lower face, and the skin relaxation after liposuction can be resolved by the RF technique. As the FSN is drawn together, the subdermal FSN tissue contracts and changes position, resulting in a face-lift effect (Figure 1). We concluded that liposuction and RF together produce a synergistic effect to achieve this satisfactory result. This 2-step method is suitable for mild to moderate skin relaxation. For patients who have considerable skin laxity, surgery is recommended. However, if the patient refuses to undergo surgery, partial improvement can be accepted, this method is also a better choice. In our study, compared with the relatively high scores of independent plastic surgeons, 21.2% of the patients considered the results to be poor or thought there was no change.

High expectations of the patient may be 1 cause, and better communication with and education of patients before surgery can reduce the incidence of this result. From another point of view, Asians have relatively tight skin compared with Westerners, so the treatment effect is not as significant.

We also realized that a major limitation of this study is the lack of stratification analysis. A comparison among different age groups and skin types is needed. Additionally, the best indications for the 2-step method should also be studied in the future.

## CONCLUSIONS

The purpose of this study was to report our experience utilizing an RF device for facial and neck rejuvenation in the largest series to date. We employed the 2-step method, in which moderate liposuction is performed first and then RF is applied to the subdermal FSN tissue. The results show high satisfaction and relatively few complications after 6 months. In conclusion, this 2-step method is an improvement on the application of RF energy for the treatment of facial and neck skin laxity. Patients achieved satisfactory to good correction of the lower face and neck contour via minimally invasive surgery.

## Supplementary Material

This article contains supplementary material located online at [www.aestheticsurgeryjournal.com](http://www.aestheticsurgeryjournal.com).

## Disclosures

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