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Noninvasive Radio Frequency for Skin Tightening and Body Contouring

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The medical use of radio frequency (RF) is based on an oscillating electrical current forcing collisions between charged molecules and ions, which are then transformed into heat. RF heating occurs irrespective of chromophore or skin type and is not dependent on selective photothermolysis. RF can be delivered using monopolar, bipolar, and unipolar devices, and each method has theoretical limits of depth penetration. A variant of bipolar delivery is fractional RF delivery. In monopolar configurations, RF will penetrate deeply and return via a grounding electrode. Multiple devices are available and are detailed later in the text. RF thermal stimulation is believed to result in a microinflammatory process that promotes new collagen. By manipulating skin cooling, RF can also be used for heating and reduction of fat. Currently, the most common uses of RF-based devices are to noninvasively manage and treat skin tightening of lax skin (including sagging jowls, abdomen, thighs, and arms), as well as wrinkle reduction, cellulite improvement, and body contouring.
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Consumer demand for noninvasive methods for skin tightening, wrinkle reduction, body contouring, and cellulite reduction is continuously growing. Patients want to look better and younger, in part due to the fear of being replaced by younger colleagues in a competitive job market. As less time for recovery means less time lost from work, patients are seeking noninvasive cost-effective procedures requiring minimal downtime to diminish skin laxity and smooth irregular body contours.

Sagging jowls are the manifestation of loss in elasticity with the resulting skin drooping, and many patients request noninvasive methods to contract or tighten the skin. These noninvasive methods include lasers, both nonablative fractional and macro spot size, focused ultrasound, and radio frequency (RF). Use of RF is typically reserved for deeper skin heating without causing ablation of the epidermis and dermis. RF devices are within the frequency range of 3 kHz to 24 GHz, which comprise the so-called ISM-RF bands, which are reserved for industrial, scientific, and medical (ISM) uses. We are most familiar with ISM bands for Wi-Fi 2.5- to 5-GHz radio bands used in the industrial sector, and this information can help explain to patients why RF is a commonplace modality. RF can be used not only to induce contraction of skin but also, in certain iterations, for reduction of fat.

By manipulating skin cooling, RF can be used for heating and reduction of fat. As the accessibility of food calories increases in Western civilization, so do the methods of reducing the effects of fat accumulation. Multiple noninvasive modalities to induce adipocyte apoptosis in pockets of fat have recently become obtainable. These modalities primarily aim at targeting the properties of fat that differentiate skin from muscle, thus resulting in the selective removal or dissolution of fat, otherwise known as lipolysis. Currently available noninvasive fat removal methods use heating, cooling, laser, RF, and ultrasound sources to more selectively target adipocytes.

The medical use of RF is based on an oscillating electrical current that forces collisions between charged molecules and ions, which are then transformed into heat. Water is the main target for this process. As a result, RF heating occurs irrespective of chromophore or skin type and is not dependent on selective photothermolysis but rather heating of water. RF-generated tissue heating has different biological and clinical effects, depending on the depth of tissue targeted, the frequency used, and the specific cool-

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ing of the dermis and epidermis. The depth of penetration of RF energy is inversely proportional to the frequency. Consequently, lower frequencies of RF are able to penetrate more deeply. RF technology also has the ability to noninvasively and selectively heat large volumes of subcutaneous adipose tissue. By selecting the appropriate electric field, one can obtain greater heating of fat or water.

RF can be delivered using the monopolar, bipolar, and unipolar devices described later in the text. The dermis is composed of collagen, elastin, and ground substances. RF-mediated thermal stimulation of this matrix results in an immediate, although temporary, change in the helical structure of collagen.[1] It is also believed that RF thermal stimulation results in a microinflammatory stimulation of fibroblasts, which produces new collagen (neocollagenesis) and new elastin (neoelastogenesis), as well as other substances to enhance dermal structure.[2] RF thermal stimulation of adipose tissue is believed to result in a thermal-mediated stimulation of adipocyte metabolism and augmented activity of lipase-mediated enzymatic degradation of triglycerides into free fatty acids and glycerol. Induction of apoptosis of fat cells is another proposed mechanism.

Methods of RF Delivery

Monopolar

The ISM bands were first established at the International Telecommunications Conference of the International Telecommunication Union held in Atlantic City in 1947. Initial use of RF for medicine included the pinpoint coagulation of blood vessels during surgery. This was the first use of monopolar RF, requiring the patient to have a grounding plate in contact with the skin. RF-induced heat ablation has been applied to other fields of dermatology, including soft-tissue (basal cell carcinoma) ablation, endovenous ablation of the saphenous system varicosities, and the treatment of vascular abnormalities. Currently, the most common uses of RF-based devices are to noninvasively manage and treat skin tightening of lax skin, wrinkle reduction, cellulite improvement, and body-contouring enhancement by influencing adipocytes. There are many devices on the market that have wide-ranging methods of RF delivery (Table 1). RF devices may be monopolar, meaning the patient is grounded and the RF is delivered through the skin, into the body, and ultimately to the grounding electrode. Typically, RF travels through structures with the highest water content with the greatest resistance of fat.

These monopolar devices may be delivered in a stamped mode in which a short cycle of 1-2 seconds is delivered while the handpiece is held in place (Thermage Solta Medical, Hayward, CA). Alternatively, monopolar RF may be delivered by either continuous movement or dynamically, where RF is delivered in a continuous pulse with constant rotation of the handpiece (Exilis, BTL, Prague, Czech Republic). In the static stamped method, a single pulse is delivered; the handpiece is then moved to an adjacent marked area and fired again. This is performed for hundreds of pulses until a premarked area is treated. Each pulse is measured for temperature while spray cooling is applied so the skin temperature does not exceed 45°C. With dynamic monopolar RF, the handpiece is continuously moved, and specific areas of laxity can be targeted in a relatively short time to reach a final temperature. The surface temperature measurements are continuously monitored, and the measurement tool is often built into the handpiece. The dynamic devices are quicker and require more technique and skill; the stamped devices are more tedious and take longer, but are easier to perform.

Bipolar

When using the bipolar method of RF delivery, the RF travels to and from the positive and negative poles, which are usually built into the handpiece. With a specific distance between the electrodes, the depth of penetration and heating is predetermined by the spacing of the electrodes and typically confined to within 1-4 mm of the skin surface. It is commonly stated that the depth of penetration is half the distance between the electrodes, but there is little evidence to support this assertion. Multiple variations of the bipolar RF concept include:

1. Fractional or fractionated RF constructed of mini-bipolar electrodes (eMatrix,e2, Syneron/Candela)
2. Bipolar-insulated needle electrodes mechanically inserted into the dermis (ePrime, Syneron/Candela)
3. Bipolar RF combined with other modalities, including diode laser or IPL (Polaris, Syneron/Candela)
4. Multiple bipolar electrodes at different distances apart firing sequentially to achieve different depths (Endymed PRO, Endymed)

Unipolar

Another form of delivery is unipolar, in which there is one electrode, no grounding pad, and a large field of RF emitted in an omnidirectional field around a single electrode. This is analogous to a radio tower broadcasting signals in all directions. Some devices new to the market are now labeled to be tripolar or multipolar but are variations of the 3 basic delivery methods (ie, monopolar, bipolar, and unipolar). Other energy sources (eg, laser or IPL) can be combined with RF. Large arrays of technologies use RF to smooth and tighten skin and reduce fat. Each of these devices have unique names and marketing associated with them, but there are individual advantages and disadvantages (Table 1). The most common uses of RF-based devices are to noninvasively manage and treat skin tightening of lax skin, including sagging jowls, abdomen, thighs, and arms, as well as wrinkle reduction, cellulite improvement, and body contouring.

RF Devices

Thermage or ThermaCool

The first device approved for RF skin contraction was the Thermage (Solta Medical, Hayward, CA) monopolar RF device, which was cleared by the US Food and Drug Administration in 2002 for sale in the United States for general sur-

Table 1 RF Devices for Skin Tightening (Courtesy of BTL, Prague, CR)

Product	Manufacturer	Frequency	Output Energy	Delivery System	Features
Monopolar Devices					
Exilis	BTL	3.4 MHz	Up to 120 W/90 W	Contact cooling	Monopolar energy flow control, safety system, built-in thermometer, no risk of overheating
CPT Comfortable Pulse Technology	Thermage Solta	6.78 MHz	400 W		New handpiece with TENS and vibrations to improve patient comfort. Pain nerval interceptors get confused and busy (vibrations, cooling, heating)
Cutera	TruSculpt	1 MHz		4″ handpiece	Handpiece that reads out once optimal temperature is reached of 43-45°C
Ellman	Pelleve	4 MHz alternating	Levels	4 small handpieces: 7.5, 10, 15, 20 mm	Several handpieces for smaller areas. Can use unit as an electrocautery unit also
Bipolar Devices					
Accent Elite	Alma	40.68 MHz	Up to 200 W	1 handpiece bipolar	
VelaShape II	Syneron	NA	IR - up to 35 W RF up to 50 W	Handpiece w bipolar RF, IR, suction	
eMatrix	Syneron	NA	25 J/cm^3	NO	
Apollo—TriPollar	Pollogen	1 MHz	50 W	3 handpieces Large, med, small	
Reaction	Viora	0.8, 1.7, 2.45 MHz	Body 50 W Face 20 W	SVC suction Vaccuum, cooling 4 modes - 0.8, 1.7, 2.45 + multichannel	
V-touch	Viora	?	?	SVC suction Vaccuum, cooling 3 handpc—0.8, 1.7, 2.45	
EndyMed PRO 3 Deep 3 Poles	EndyMed Medical	1 MHz	65 W	4 handpieces body contour, body tight, facial tightening, fractional	3 deep RF, skin tightening HP, body contouring HP, facial tightening HP, fractional skin resurfacing HP
Venus Concept - 8 Circular Poles	Venus Freeze	RF: 1 MHz, Mag: 15 Hz	RF: up to 150-W Mag flux: 15 Gauss	Large handpiece 8 poles 5 mm apart, dual mode = bipolar + magnetic field	Multipolar RF and magnetic pulse
TiteFx	Invasix	1 MHz	60 W	Bi–RF + vaccuum	Bipolar w suction real-time epidermal temperature monitor

gical use. In 2004, clearance for periocular wrinkles was obtained. The initial indication that was promoted was treatment of the forehead for eyebrow elevation. Soon after, dermatologists were testing the device for treatment of sagging jowls and skin tightening in other body areas, such as the abdomen and thighs. The US Food and Drug Administration cleared Thermage for body contouring in 2006. Larger handpieces to cover larger areas were also introduced (Fig. 1).

There are 3 components to the ThermaCool device: (1) the RF generator, (2) the handheld tip with a thin membrane, and (3) a cryogen unit. To deliver cooling, other units use Peltier cooling. Sensors in the thin membrane tip measure temperature and tissue contact. The membrane electrode is designed to disperse energy uniformly across the skin surface in a process termed capacitive coupling, which creates a zone of increased temperature at depths of 3-6 mm.[3] The depth of heating depends on the size and geometry of the treatment tip.[4] Theoretically, the device heats the dermis from 65 to 75°C, the temperature at which collagen denatures, whereas cooling allows epidermal temperatures between 35 and 45°C. Zelickson and colleagues evaluated the effects of RF (ThermaCool) on 2 samples of human abdominal skin treated with energy ranging from 95 to 181 J.[1] The treatment effect was evaluated using light and electron microscopy of punch biopsies taken immediately and up to 8 weeks after treatment. Immediately after treatment, a mild perivascular and perifollicular infiltrate was observed. At 0, 3, and 8 weeks after treatment, electron microscopy revealed collagen fibrils with greater diameter (shortening of collagen fibers) compared with collagen fibers evaluated pretreatment, up to 5 mm deep in the skin.[5]

The most recent model, the ThermaCool NXT, has incorporated additional features with several tips and handpieces. These include tips for the body and eye and a handpiece for cellulite. A new Comfort Plus Technology tip is also available, which incorporates massage with RF energy delivery, increasing the speed of the procedure yet making it more comfortable by blocking pain using vibration.

Some studies have analyzed the use of RF devices on subcutaneous fat and circumferential reduction in the size of

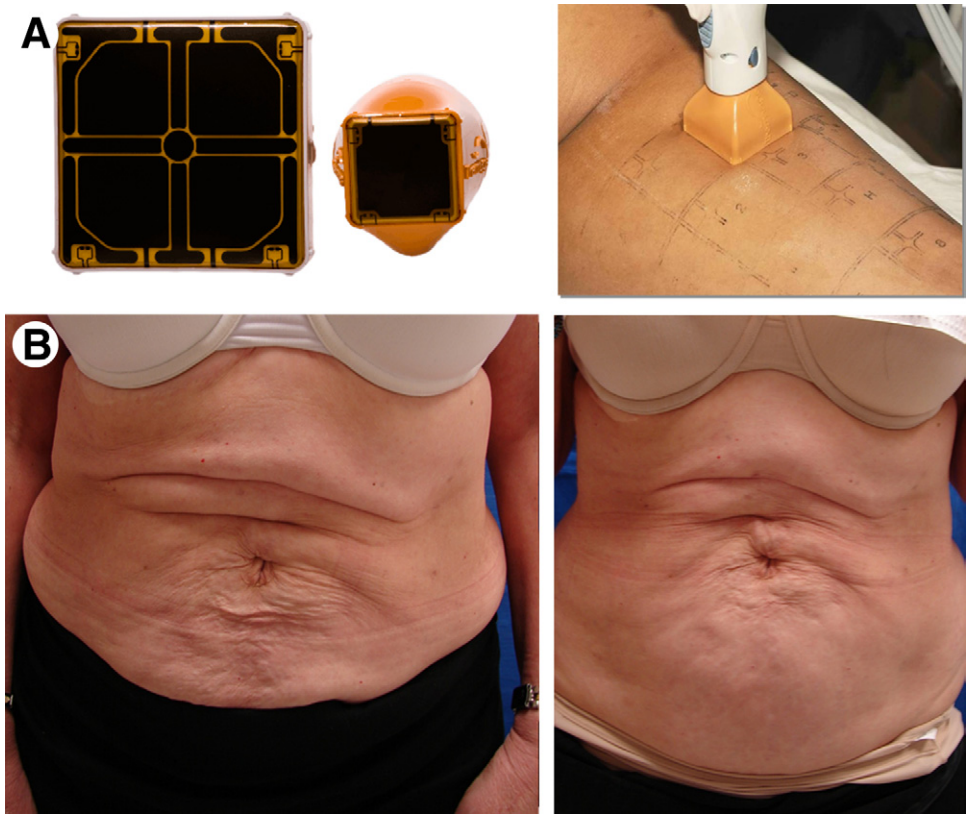

Figure 1 (A) Large (3 cm) vs small (1 cm) handpieces for ThermaCool monopolar device (Solta, Hayward, CA). Using the larger 3-cm handpiece, it is possible to treat larger areas like the abdomen. (B) Clinical result of skin tightening on the abdomen using ThermaCool device. Seen at 2 weeks after one treatment.

treated areas. A summary of studies is shown in Table 2. An interesting study used the ThermalCool TC (Solta Medical, Inc, Hayward, CA) device with the Thermage Multiplex Tip to evaluate its effect on abdominal skin laxity and waist circumference.[13] Twelve subjects were treated in this study, and results demonstrated an average decrease in waist circumference of 1.4 cm at the 1-month follow-up visit. Another study using a different monopolar RF device was able to demonstrate that adipocyte cell death occurred from thermal injury and was evident starting at 9 days after treatment.[14] Foamy histiocytic and granulomatous infiltrates were observed after cell death around the adipose tissue, but no increase in circulating lipid levels was seen.

Jacobson et al[9] treated 24 patients with laxity of the neck, nasolabial folds, marionette lines, and jawline using the ThermaCool system. Each patient received 1-3 monthly treatments that consisted of 2 passes on the forehead, 3 on the cheek, and 1 on the neck using 106-144 J. Seventeen of the

Table 2 Studies Evaluating the Effects of Monopolar RF

Authors	Type of Study	Results
Fitzpatrick et al[6]	Multicenter nonrandomized blinded clinical trial	Periorbital wrinkles improvement and brow elevation; 50% patient satisfaction
Bassichis et al[3]	Nonrandomized nonblinded	Objective improvement in brow elevation, but majority of patients do not appreciate improvement
Nahm et al[7]	Nonrandomized nonblinded split face	One side of brow treated in 10 patients, objective elevation on treated site in all 10
El-Domyati et al[8]	Histologic study	Six patients with statistically significant increase in collagen I and III, and newly synthesized collagen, while elastin was decreased
Jacobson et al[9]	Nonrandomized nonblinded	Subjective improvement in lower face skin tightening
Alster et al[10]	Nonrandomized nonblinded	Subjective improvement for cheek laxity and submental laxity
Weiss et al[11]	Retrospective chart review	Largest patient experience in >600 patients, few adverse events, all short-term, 85% patient satisfaction
Zelickson et al[1]	Electron microscopy	Abdominal skin collagen fibril contraction with tissue contraction and thermally mediated wounding, new collagen production seen

Adapted with permission from Lolis et al.[12]

24 patients showed improvement by 1 month after treatment, and results continued to improve 3 months after treatment. Transient burning pain was described by most of the patients. Patients who underwent multiple treatments and passes had greater results. Alster and Tanzi reported similar findings with the ThermaCool system, with improvement in moderate cheek laxity and nasolabial folds in 30 patients treated with monopolar RF.[10]

Weiss et al[11] published a retrospective chart review to establish the rate and seriousness of side effects, as well as patient satisfaction. More than 600 patients were treated using the ThermaCool device for mild laxity. Patients were treated with multiple passes with fluences of 74-130 J/cm^2 using a 1-, 1.5-, or 3-cm^2 tip. The most common side effects were erythema and edema lasting <24 hours. Transient erythema resolved within 5-20 minutes, with <5% reporting erythema lasting up to 72 hours. The most significant side effects occurred with the original 1-cm^2 tip and included 1 case of superficial crusting that resolved in 1 week, 1 case of a slight depression on the cheek that lasted for 3.5 months, 3 cases of subcutaneous erythematous papules, and 3 cases of neck tenderness lasting 1-4 weeks. The overall rate of unexpected adverse side effects with the first-generation device was 2.7%, but with subsequent generations and using the multiple-pass lower-energy treatment algorithm, no adverse effects have been seen. Patient satisfaction was high at 90%.

Monopolar RF has also been used to treat active cystic acne to inhibit sebaceous activity and promote dermal contouring. A study including 22 patients with moderate to severe active cystic acne reported improvement using stamped monopolar RF.[15] Patients were treated in 1-3 sessions using 65-103 J/cm^2. A 75% reduction in active acne lesion count was seen in 92% of patients, and a 25%-50% reduction occurred in 9% of patients. Often a decrease in active lesions was accompanied by improvement of underlying scarring. These results have not been duplicated in other studies.

Exilis Device

The Exilis (BTL, Prague, Czech Republic) is a novel RF dynamic monopolar device that combines focused monopolar RF delivery with a number of built-in safety features, including Peltier cooling (Fig. 2). The Exilis system delivers the energy through 2 different hand applicators, one designed for the face and one designed for the body. The goal of treatment is to raise the surface temperature to 40-42°C for 4-5 minutes for each region treated. When this temperature is reached, the patient feels a comfortably warm sensation. The handpiece is in continuous motion so the areas of skin with the most laxity can be specifically targeted. This has been termed dynamic monopolar RF. Additionally, Peltier cooling can be adjusted up or down to allow targeting of skin or subcutaneous tissue. For example, to drive heating more deeply, the skin is cooled and protected, allowing heat to reach into the subcutaneous fat. Alternatively, to get maximum effect on skin laxity, cooling is turned off and heating of the skin occurs quickly, with minimal effect on subcutaneous fat.

For the body applicator, the skin temperature is monitored and continuously displayed by an on-board infrared temperature sensor. When the device senses spikes in RF delivery, these spikes are automatically reduced. Constant monitoring of energy flow through tissue (impedance) detects tip contact with skin. The device is equipped with an energy flow control system, which automatically shuts off the device when the tip contact and/or energy flow is disrupted and virtually eliminates the risks of burns. The energy flow control allows use of high power (watts), which then leads to faster treatment times while ensuring the greatest level of safety and comfort.

This device also warns when RF is not being delivered. Experiments have shown that the increased temperature effect is seen as much as 2 cm below the skin with surface cooling (Fig. 3). The primary advantage of this system is the ability to target skin laxity or contour deformities. A precise depth of penetration combined with the focused thermal effect due to advanced controlled cooling allows total body and full face applications. A cohort of 30 patients who were treated with the Exilis device on the jowls and neck for rhytid and laxity, as well as submental fat pad reduction, were followed for 6 months (Abstract accepted for presentation at the American Society for Laser Medicine & Surgery's 33rd ASLMS Annual Conference; April 3-7, 2013; Boston, Massachusetts). The age range was 31-66 years. Additionally, 14 of the facial treatment patients were also treated for "jiggly" fat pads or loose skin on the arms between the shoulder and elbow. Circumference was measured mid-arm. The treatment target was fat pad and circumferential reduction and/or tightened skin. Patients were weighed and photographed before and after the study and were instructed to continue with their current lifestyle and not to change their nutrition, caloric intake, or physical activity routines.

The treatment protocol is 10 minutes for a 20 × 25-cm area, maintaining surface temperatures of 40-42°C, for 4 treatments, with each treatment spaced at 7-10 days. Skin temperatures at the end of a treatment cycle were typically 40°C, which rapidly dropped at the conclusion of the treatment. The patients were treated lying down comfortably, with the treatment area exposed. A water-based gel (face) or mineral oil (body) was applied to the treatment area before the onset of treatment. Baseline temperature before treatment was typically 32°C.

The energy and treatment times were adjusted according to the area being treated. For the face, typically 30 W with 100% duty cycle was used. For the body, 50-80 W with 100% duty cycle was used. The RF applicator was applied to the skin and maintained contact with the skin through each 30-second treatment cycle. Circular motions or to-and-fro motions were used to keep the tip moving over the treatment area. The key is not to allow the RF applicator to stop moving but to focus on areas of greatest concern. According to patient feedback, the energy was adjusted up or down, as tolerated, to achieve a sustained surface temperature of 40-42°C with a rapid slope up from baseline.

In a recent study, 20 subjects had 4 circumferential treatment sessions with the Exilis device for the upper arm (Abstract accepted for presentation at the American Society for

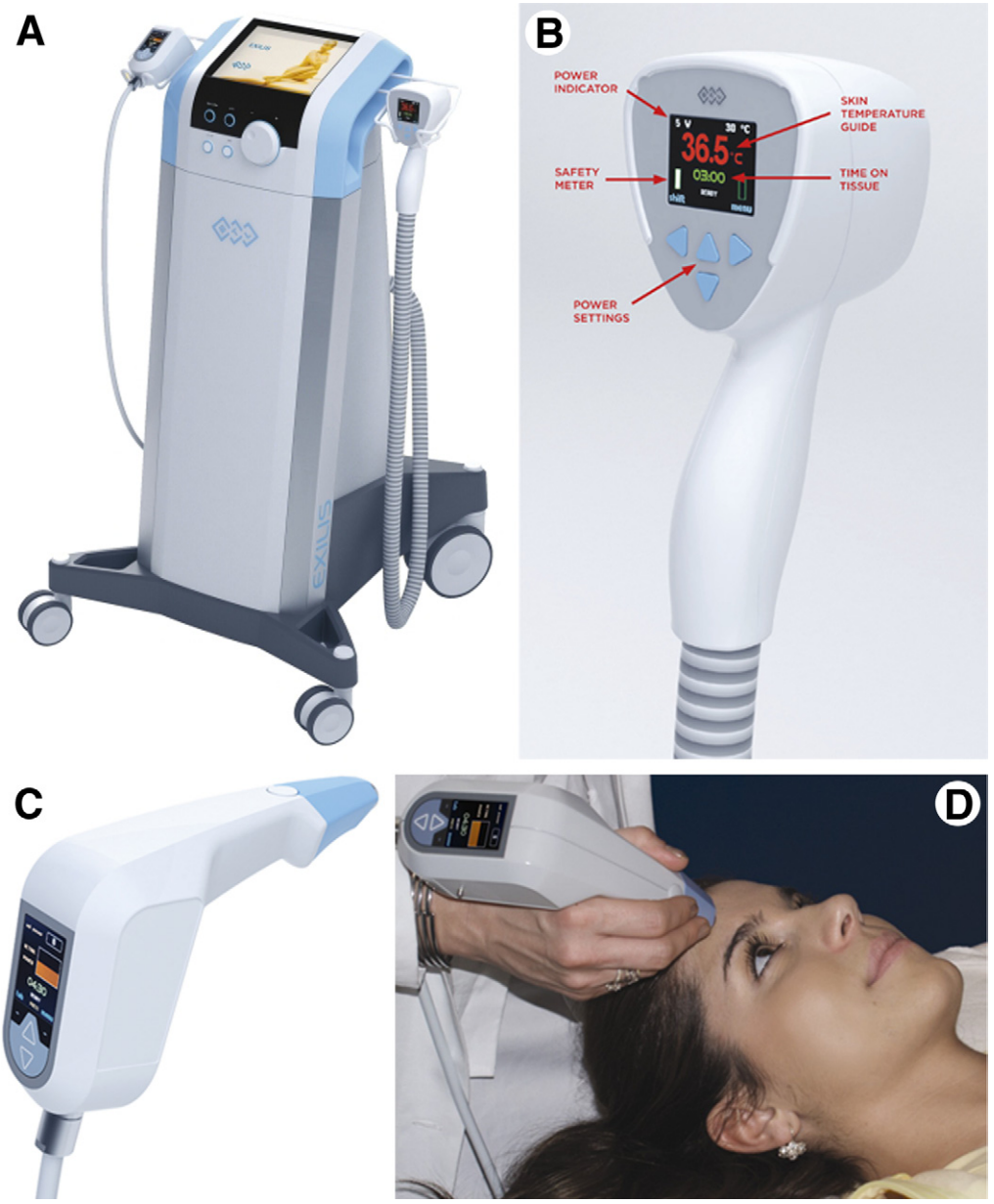

Figure 2 Device design for Exilis system (BTL, Prague, Czech Republic). (A) Unit with 2 handpieces. (B) Body treatment handpiece with temperature monitoring. (C) Facial treatment handpiece design. (D) Treatment with facial handpiece.

Laser Medicine & Surgery's 33rd ASLMS Annual Conference; April 3-7, 2013; Boston, Massachusetts). Treatment outcome was not measured by images or circumference but by ultrasound thickness of the fat layer. Measurements were taken at precise reproducible points on the arm. Authors reported average posterior fat reduction for the arm of 0.5 cm vs 0.02 for the untreated control arm. This was a statistically significant measurement of fat reduction by ultrasound fat layer thickness. Examples of clinical results for monopolar RF devices are shown in Fig. 4.

Accent Unipolar Device

The Accent (Alma Lasers, Inc, Fort Lauderdale, FL) RF system is designed for continuous skin contact using 2 handpieces: the unipolar to deliver RF energy to the subcutaneous adipose tissue for volumetric heating, and the bipolar to deliver RF energy to the dermis for nonvolumetric heating. It uses both unipolar and bipolar RF and delivers different depths of RF current to the skin, theoretically bipolar for more superficial heating and unipolar for deeper dermal heating. Several clinical trials describe its use in reducing the appearance of cellulite and its effects on tissue tightening.[16-18] In a randomized, blinded, split-design study, 10 individuals (aged 32-57 years) with a clinically observable excess of subcutaneous fat and cellulite (minimum grade 2 out of 4) on the thighs received up to 6 unilateral treatments at 2-week intervals with unipolar RF. All participants responded to a mean of 4.22 treatments, with a range of 3-6 treatments. Blinded evaluations of photographs using the cellulite grading scale demonstrated an 11.25% mean improvement. The treatment was painless, and side effects included minimal to moder-

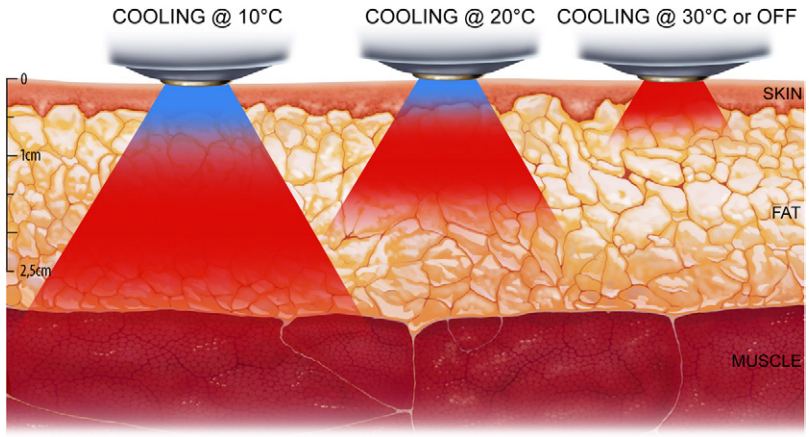

Figure 3 Monopolar RF depth can be controlled by cooling, depths of >2 cm can be achieved (Courtesy: BTL, Prague, Czech Republic).

ate erythema, which resolved within 1-3 hours. No crusting, scarring, or dyspigmentation was observed. However, clinically visible and quantified improvement did not achieve statistical significance.

Combination RF and Light (ELOS)

The most widely used combination RF systems are those that use IPL, a diode laser, or infrared light. One system (Aurora SR, Syneron Medical, Ltd, Yokneam, Israel) uses IPL as its optical energy source, with wavelengths between 400 and 980, 580 and 980, and 680 and 980 for different targets or chromophores. RF energies up to 25 J/cm^3 can be generated with dermal penetration of 4 mm.[19] Another system (Polaris WR, Syneron Medical, Ltd) is a combined 900-nm diode laser with RF energy. Optical and RF energies are delivered simultaneously through the bipolar electrode tip. Optical energy fluences range from 10 to 50 J/cm^2 and RF energies from 10 to 100 J/cm^3.[12] Another ELOS device (VelaSmooth, Syneron Medical, Ltd) uses a combination of infrared light (700-2000 nm), RF energy, and suction with mechanical massage for the treatment of cellulite.[20] All devices have been reported to lead to moderate improvement.

Bipolar RF Plus Vacuum

The Aluma RF plus vacuum device (Aluma System Lumenis, Inc, Santa Clara, CA) is composed of an RF generator, a handpiece, and a tip with 2 parallel electrodes. When the handpiece with the tip is placed perpendicular to the surface of the skin, the system produces a vacuum, which suctions a small area of skin.[21] The skin becomes a U-shaped area with

Figure 4 Clinical results with monopolar RF. (A) Before and immediately after third treatment for sagging. (B) Submental before and after 4 treatments. (C) Flanks (muffin top) before and after 3 treatments. Treatments using Exilis BTL monopolar device.

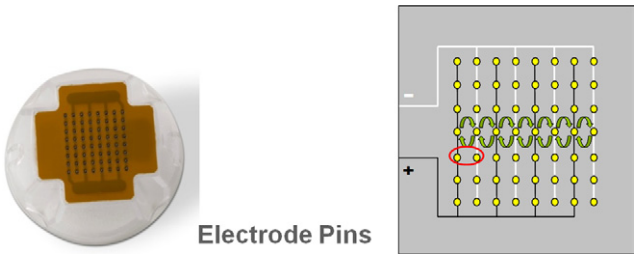

Figure 5 Fractional RF tip showing flow of current from microelectrodes. Flow is from positive to negative (Syneron/Candela).

epidermis on both sides and dermis and connective tissue in the middle. The design is to allow the energy emitted to reach the middle and deep dermis. When 46 patients with 8 facial treatments, every 1-2 weeks, were evaluated, statistically significant improvement in facial wrinkles was observed.[22] A low incidence of adverse events such as burning and crusting was reported. Another study reported clinical improvement in 30 patients treated with 6-8 cycles of the vacuum plus RF system. Patients were treated for multiple clinical conditions, including periocular and glabellar wrinkles, striae distensae, and acne scars. By histology, there was less collagen atrophy and greater interstitial edema of treated skin compared with untreated skin, which showed atrophic dermal collagen with elastotic changes.[23]

Fractional RF

Fractional RF is another form of bipolar RF delivery with mini-electrodes. The concept is that RF is omnidirectional so that dots of RF spread out from the point of contact in comparison with laser, in which the energy is attenuated in a sharp fashion in interaction with tissue (Fig. 5). Fractional RF has been used mainly for skin rejuvenation. Less than 1-mm thermal injuries are formed in a patterned fractional array directly to the reticular dermis. The area directly in contact with and below the array of microneedles or electrodes is selectively heated, whereas the areas between the targeted areas are left intact. A prospective multicenter study was conducted on 35 subjects who received 3 treatments on their entire face with a fractional device (eMatrix RF, Syneron/Candela Medical, Ltd).[24] Clinical improvement was assessed 4 weeks after the last treatment using photographic analysis. Eighty-three percent of patients showed improvement in skin brightness, 87% in skin tightness, and 90% in smoothness and wrinkling. Subjects undergoing facial treatment had minimal pain, no permanent side effects, and no significant downtime. Investigators' assessment for improvement in skin texture correlated with subjects' evaluation and was >40% for approximately 50% of subjects. Eighty percent of the subjects were satisfied with the results. Higher energy levels and lower coverage rates produced better esthetic results along with less pain.

Safety

A recent advance has been a novel kind of RF energy delivery system that allows constant monitoring of the real-time local skin impedance changes during RF skin treatment (BTL Elite, BTL Aesthestics, Prague, Czech Republic). This Impedance Compensation system controls the energy supply while the circuitry automatically compensates for impedance changes. Energy flow is controlled, and the computer automatically keeps the heating power on the optimal level even in areas of higher/lower impedance, allowing the operators' use of high power settings without compromising safety. The system enables the energy to be evenly and precisely dosed over the whole treatment area, allowing for maximum clinical efficacy. This is important because impedance varies greatly in areas of the face where the bone is close to the skin surface. Without monitoring of impedance, this may lead to overheating and blistering. Arcing and serious skin damage may occur when the contact between the applicator and the tissue is not ideal or the applicator is lifted, but with the new circuitry, energy is immediately cut off when sudden impedance changes are detected.

Conclusions

RF is commonly used for tissue heating and tightening. Competitive technologies include vacuum massage, infrared laser technologies, high-frequency focused ultrasound, cavitation frequency ultrasound, RF energy, and various hybrid energy devices combining some or all of the above. Monopolar RF excites molecules (2-3 million times per second) to create desirable heating effects on collagen and subcutaneous tissues. Many devices use a combination of heat and cooling to noninvasively deliver RF energy to specific depths in tissue, which produces a predictable response, notably collagen remodeling, to achieve desired cosmetic results for wrinkle reduction, tissue tightening, and body contouring. Monopolar RF plays an important role in our practice for treatment of sagging jowls and mild body contouring. It is a safe technology, which is continually being made safer.

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