

Aesthetic Applications of Radiofrequency Devices



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KEYWORDS

• Noninvasive • Monopolar • Bipolar • Multipolar • Radiofrequency • Laxity • Face • Neck

KEY POINTS

- Multiple generations of radiofrequency devices exist for noninvasive rejuvenation of the face and neck.
- Devices differ in the number of electrodes and additional energy modalities they combine to maximize clinical effects while minimizing adverse effects.
- Several peer-reviewed studies have been published demonstrating their safety and efficacy for noninvasive face and neck rejuvenation, and applications such as treatment of acne.

INTRODUCTION

During the recent years, there has been a paradigm shift in the field of dermatology. Whereas some years ago traditional skin disorders such as psoriasis or inflammatory conditions were common complaints, today there is a dramatic increase in demand from patients for skin rejuvenation, meaning any effective, safe, painless, and low-cost way they can exploit to secure their youthfulness, and the health and glow of their aging skin.¹ Technological advances have led to a surplus of medical devices, with more entering the arena, that boast sophisticated mechanisms to achieve skin rejuvenation. This present state of affairs necessitates that physicians intricately understand how energy-based devices work and the myriad of aesthetic applications they can have for the face and body.

Various types of energy have been exploited to target the skin layers such as lasers, ultrasound, acoustic waves, and radiofrequency (RF) waves, and as expected they all come with their advantages and limitations. RF, of all the energy-based treatment, is perhaps the most versatile in terms of the number and types of devices that exist

and the aesthetic indications they can ameliorate. The basic mechanism underlying RF skin rejuvenation is using the tissue's resistance within the various layers of the skin to transform the RF energy into thermal energy. Successful transfer of RF into thermal energy, depends on the size and depth of the tissue being treated, and because the energy produced is an electrical current instead of a light source, tissue damage is minimized and epidermal melanin remains unaffected; thus, RF can be used for patients of all skin types. Generally, current RF treatments are associated with few complications and adverse effects while allowing a quick recovery time.^{2,3}

Based on their number of electrodes, noninvasive RF devices are commonly categorized as monopolar, bipolar, tripolar, multipolar, and multigenerator. Moreover, popular approaches among the technology manufacturers are to combine additional energy modalities within 1 device, allowing for enhanced efficacy and reduced adverse effects. Examples include RF devices integrated with vacuum systems, broadband/infrared light, lasers, and pulsed electromagnetic fields (PEMFs). This continuous diversification of

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devices and refinement of their features has allowed their application in an increasing amount of aesthetic indications in the face and body. Indeed, whereas some years ago RF was almost exclusively used for facial skin laxity, it has now become in many cases the preferred treatment for treating acne scars, cellulite, postpartum laxity, photoaging, and localized fat reduction. Although there is still a paucity of protocols and standardized methodologies for an individual device and most treatments are empirical, there is a vast amount of peer-reviewed publications that substantiate their merit as a key clinical utility.

Patient selection is key in noninvasive aesthetic rejuvenation; responder rates to noninvasive RF treatments seem to plateau, with around 60% of treated patients being satisfied regardless of the device used. This variability could be related to different treatment protocols, body area treated, and patient selection. A thorough consultation and gathering of vital information such as patient age, degree of laxity, history of smoking, ethnicity, body mass index, and pain threshold can focus the clinical strategy to optimize the anticipated results. Great candidates are patients that are young with minimal laxity, patients who have developed postoperative laxity, and surgery-adverse patients. Patients with implantable devices, mental illness, and those with expectations of laxity elimination would be discouraged from engaging in treatment.⁴

MONOPOLAR RADIOFREQUENCY

Monopolar RF devices use a high-frequency electric current, which produces heat in a volumetric manner that flows through the transducer to a grounding pad on the subject's body heating the deep dermis (3–4 mm), subcutaneous fat and fibrous septae while leaving the epidermis unaffected. The resulting transfer of thermal energy leads to collagen denaturing, localized lipolysis, and the stimulation of wound-healing cascades that rejuvenate the tissue with growth factors, with the end result being the desired skin tightening/smoothing effect. Depth of heating depends on the size and shape of the treatment tip being used, while a conductive coupling fluid is used during the treatment to enhance the thermal and electrical contact between the treatment tip and the skin. Although immediate improvement is noted in terms of laxity, the remodeling proceeds over a period of 4 to 6 months.^{5–7} The phenotypic manifestations of skin tightening have been substantiated by histologic analysis that has shown that application of monopolar RF leads to up-regulation of collagen gene expression and messenger RNA.⁸

The first monopolar RF device was cleared by the US Food and Drug Administration for treatments of facial rhytides in 2002 and is still heavily used today after undergoing multiple technical refinements (Thermage; Solta Medical, Hayward, CA), such as the incorporation of a vibration setting in the hand piece to decrease pain and the addition of a cryogen unit that prevents inadvertent damage such as blistering or crusting of the epidermis. In general, energy levels between 14 and 24 J/cm² are used, with an average of 900 pulses, and vibration levels of 1, 2, and 3. Energy is delivered in a “stamped” mode, with short cryogen cooling bursts throughout the treatment, and temperature is continuously measured so the epidermal temperature does not exceed 45°C, but the heat delivered to the dermis is about 45°C.

Other monopolar devices used for aesthetic application, demonstrated nuances in their features, such as the Exilis RF devices (BTL Aesthetics, Prague, Czech Republic) or the Pelleve (Cynosure/Ellman of Westward, MA). The Exilis RF device allows a continuous motion to deliver RF energy, has a cooled gliding electrode tip to increase patient comfort and integrates an “energy flow control system” that eliminates peaks of RF thus improving treatment control. RF delivered with the Exilis device can target either skin laxity, or subcutaneous fat, and treatment protocols are 10 minutes for a 20- to 25-cm area, keeping surface temperature at 40°C to 43°C, repeated 4 times in weekly intervals. The Pelleve device in contrast emits RF energy in the form of electromagnetic waves, and cools the epidermis both with a gel and by convection to the surrounding air, while an infrared laser thermometer ensures temperature in the epidermis stays between 41°C and 43°C.⁹

Several peer-reviewed clinical studies have shown that the application of monopolar RF can result in improvement of face and neck skin laxity. In a study of 50 subjects receiving monopolar RF (Thermage, Solta Medical; 97–144 J/cm²) for treatment of cheek, submental, and neck laxity, significant improvement was observed in the majority of patients, and patient satisfaction scores were consistent with the clinical improvement seen.¹⁰ In a retrospective study conducted to evaluate the efficacy and safety of the newer generation Thermage RF device, 64 patients with mild to moderate facial skin laxity were treated to the forehead, cheek, jawline, and upper neck. Treatment parameters were 14 to 24 J/cm², 900 pulses, and the area was treated with 2 consecutive passes. At the 10-month follow-up, 80% of participants reported improvement of skin texture and laxity, and no adverse effects.¹¹ In another study using Thermage in the face and neck, 24 patients

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