

The use of RF Energy in Aesthetic treatments

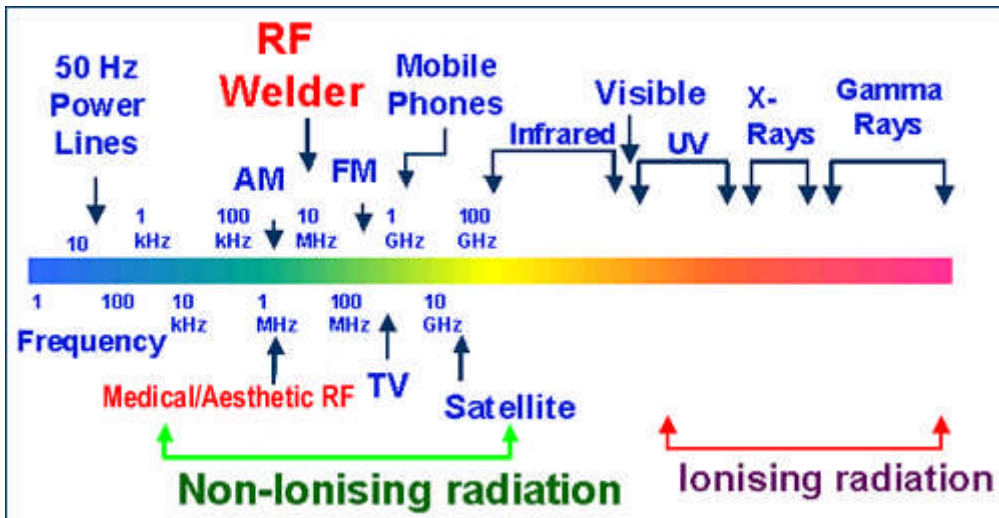
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In recent years, publicity, speculation, and concern over claims of possible health effects due to Radio Frequency (RF) emissions from a variety of everyday consumer products such as cell phones has prompted questions to be asked regarding devices that also use RF of higher output that have been designed for use in aesthetic treatments.

There are a number of devices on the market that use either mono polar or bipolar RF to provide rejuvenation and epilation effects by controlled dermal heating, and in this discussion, we will look specifically at the use of RF energy in hair removal and facial rejuvenation that the beauty therapist and aesthetician would employ.

RF and biological effects

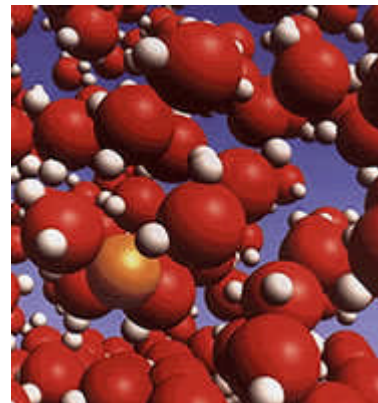
The RF part of the electromagnetic (EM) spectrum is generally defined as that part of the spectrum where electromagnetic waves have frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300 GHz). Microwaves are a specific category of radio waves that can be defined as radiofrequency energy where frequencies range from several hundred MHz to several GHz.



The Electromagnetic wave spectrum

Radiofrequency radiation, especially at microwave frequencies, can transfer energy to water molecules. High levels of microwaves will generate heat in water-rich materials such as most foods. This efficient absorption of radio frequency energy via water molecules results in rapid heating throughout an object, thus allowing food to be cooked more quickly in a microwave oven than in a conventional oven.

Not surprisingly, human tissue has the same properties of foods in the respect of being a water-rich material, and reacts to the energy in the same way, and the biological effects that result from heating of tissue by RF energy are often referred to as "thermal" effects.



The water rich tissue in the target area is heated in the same way a microwave heats food

It has been known for many years that exposure to very high levels of RF radiation above 3MHz can be harmful due to the ability of RF energy to heat biological tissue rapidly.

In devices used for aesthetic purposes, the RF frequency used is much lower, (typically 1-2 MHz) and consequently less likely to cause thermal damage unless exposed for prolonged periods where excessive heating occurs.

Why use RF?

In devices used for both epilation and facial rejuvenation, the RF is used in conjunction with a laser or intense pulsed light (IPL) source.

The role of the RF is to pre-heat the target tissue in the treatment area so the light source can work more efficiently and with less energy required to denature the targeted pigment or hair follicle.

The theory of how this works is the tissue in the treatment area is uniformly heated to a safe level with the RF, (The RF energy being absorbed by all of the tissue in the treated area as it is not attracted to a particular chromophore) with the following laser or IPL energy pulse being attracted to and absorbed only by the darker chromophore of the pigment or hair follicle.

The energy required to heat the darker material to a temperature that will denature/destroy it will be less than if the light source had to heat it from body temperature.

The hypothesis is that this minimises thermal shock to the tissue, as heat can permanently damage human tissue at temperatures from 107° F and above. The higher the temperature, the greater the destruction.

Light based ablation reduces this thermal shock to the surrounding tissue by concentrating its heat in the darker regions, which are usually the areas to be denatured. Areas of lighter tissue will not heat as quickly as darker areas, and the energy source is removed before damage occurs. (When correctly used)

Of course with a high blast of energy, there will always be a degree of “heat soak” through the treated area, and this is why cooled flash lamps and the practice of pre-cooling the treatment area is carried out.

The perception of RF

While the use of RF to help reduce this thermal shock has its merits, the perception that the treated area is being “microwaved” may not appeal to many clients.

The reality is that the tissue is being heated in the same way a microwave oven heats and cooks food, although technically the frequency used is not in the microwave spectrum.

The perception of potential RF dangers is based on the understanding that the energy delivered to the human tissue during a treatment with a RF device is far higher than experienced during the use of a telecommunications device, (where all the hoo-ha started) with opponents to the use of RF in aesthetic treatments believing that as a client typically undertakes multiple treatments, the RF and subsequent heating of the same areas occurs and this is where there is potential for long-term damage to arise.



There are public concerns over exposure to RF from a variety of sources

It is known that electromagnetic energy is “non-ionizing” – which means it is not strong enough to ionize atoms and molecules in cells (ions are electrically charged particles that, like magnets, are drawn toward positive or negative poles). “Ionizing” radiation (e.g. gamma rays and x-rays), on the other hand, affect the chemical makeup of cells, and alter their genetic code. Theoretically, RF should be safer, however in the absence of studies conducted on the long-term effects on tissue post multiple treatments with RF, we can only hope that no detrimental genetic disruption has occurred.

RF in medicine

The reality is that the use of RF in this manner on the human body is not new. It has been used in oral, ophthalmic, and

gynaecological surgery for over 50 years. RF energy is used in medicine for surgical ablation.

This Interstitial thermotherapy with radio-frequency current (RFITT) is used in the same manner as lasers and other energy sources. In these applications, the delivery of the RF to the tissue is highly controlled using needles and specially shaped probes to reduce the RF exposure and subsequent damage to surrounding tissue. Typical contact areas in these applications are 25 mm³ (0.25cm³)

In the devices used for epilating and skin rejuvenation, the delivery of the RF to the tissue is to a larger surface area, (up to 3 cm²) and up to a depth of up to 6mm.

This is a 1.8cm³ area or 12 times larger area than used in the medical application, and the heat will dissipate much more quickly. Even though the level of RF energy delivered to the skin can be up to 100 Joules per cm³, with careful application the skin should not be damaged.



RF has been used medically for over 50 years

Safety guidelines for human exposure to RF

In all developed countries there are guidelines for human exposure to RF electromagnetic fields, with guidelines derived from the recommendations of expert organisations such as the National Council on Radiation Protection and Measurements (NCRP) and the Institute of Electrical and Electronics Engineers. (IEEE)

Expert scientists and engineers developed both the NCRP exposure criteria and the IEEE standard after extensive reviews of the scientific literature related to RF biological effects. The exposure guidelines are based on thresholds for known adverse effects, and they incorporate appropriate margins of safety.

The NCRP, IEEE and ICNIRP exposure guidelines identify the same threshold level at which harmful biological effects may occur, and the values for Maximum Permissible Exposure (MPE) recommended for electric and magnetic field strength and power density in both documents are based on this threshold level.

The common threshold level for most international health agencies is a Specific Absorption Rate (SAR) value for the whole body of 4 watts per kilogram (4 W/kg), and with an average client weight of over 45Kg, the 70-100 Joules per cm³ (equivalent to 70-100W/sec) output of the RF used in aesthetic devices, it could be reasonably concluded that it is well below this SAR value.



Summary

The frequency and energy levels of the RF used by these devices would appear to be within safe limits for the level of exposure relative to average size and body weight of clients. The aesthetic devices that radiate RF all appear to have built-in safety features that monitor skin temperature, thus reducing the risk of excessive thermal damage.

Footnote: Is the use of the combination of RF & IPL effective?

One of the main marketing points of the use of a combination of RF and light energy is that of the ability to treat lighter hair in hair reduction programs, and darker skins for pigmentation and rejuvenation, however after receiving various feedback about the level of success, and reading journals and the white papers and quotes from the researchers appointed by the companies who market the devices, judgement is reserved.

For many discerning therapists and aestheticians, anecdotal evidence is generally not enough when it comes to making decisions about purchasing devices that potentially cost more than a new luxury car. If you are contemplating the introduction of this technology, do your homework and ask questions.

During the examination of research material for this article, there appeared to be a common

summary, and apart from the safety aspect of RF in these treatments, the question begs: Is the use of a combination of RF and light energy worthwhile and effective?

In the absence of credible comparative (compared to purely light based modalities) studies, the only information readily available regarding efficiency is provided by the marketers of the devices and researchers who appear to be funded by the manufacturers. (?)

A sample of the summary quotes from the research papers read:

“Hair removal efficiency was greater in subjects with dark hair (mean clearance 80-85%). This is similar to that reported using other light based technologies” [1]

“Although results may not be quite as efficient as with chromophore-targeting primarily light based technologies, it does offer a new approach to this previously refractory group of photoepilatory individuals” [2]

“Comparative studies are needed to determine whether the combination of RF and light based energy is indeed more effective and safer than either light or RF sources used alone” [3]

“Further comparative studies looking at the effect on hair RF alone versus light and RF are needed” [4]

Reference Quotes:

[1] Combination Radiofrequency and Light Energies: Electro-optical Synergy Technology in Esthetic medicine. Neil S. Sadick, MD, FACP, FAACS (Dermatol Surg 31:9 Part 2: September 2005)

[2] Effective epilation of white and blond hair using combined Radiofrequency and optical energy. Neil S Sadick & Sharyn A Laughlin (page 30 J Cosmet Laser Ther 2004)

[3] Combination Radiofrequency and Light Energies: Electro-optical Synergy Technology in Esthetic medicine. Bernard Cohen, MD, Neil S. Sadick, MD, FACP, FAACS (Dermatol Surg 31:9 Part 2: September 2005)

[4] Effective epilation of white and blond hair using combined Radiofrequency and optical energy. Neil S Sadick & Sharyn A Laughlin (page 30 J Cosmet Laser Ther 2004)

Further suggested reading:

Journal of Cosmetic Dermatology, January 2002, page 142

Lasers in Surgery and Medicine (November 2003, pages 232–242)

Cosmetic Dermatology, December 2003, pages 28-34)

Cosmetic Surgery Times, “New Trends Spur Doctor, Patient Education,” July 1, 2004