High Intensity Focused Electromagnetic Field (HIFEM) Devices in Dermatology

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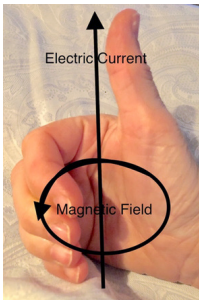
Electromagnetic field devices, specifically high intensity focused electro-magnetic field (HIFEM), comprise the latest class of technologies being developed for dermatologic applications. The FDA clearance of these technologies includes such intended uses as "the stimulation of neuromuscular tissue for bulk muscle excitation in the legs or arms" and "improvement of abdominal tone, strengthening of the abdominal muscles, development of firmer abdomen; strengthening, toning and firming of buttocks, thighs and calves; and improvement of muscle tone and firmness, for strengthening muscles in arms."[1,2]

Electromagnetic fields are composed of both electric and magnetic fields. Electromagnetic phenomena are defined by the electromagnetic force which in turn includes electricity and magnetism. Electric fields are the result of electric charges, measured in volts per meter (V/m). Magnetic fields arise from the movement of electric charges as in a current and measured in tesla (T) or the gauss (G; 10.000 G= 1 T). While electric fields are shielded by wood and metal, magnetic fields easily pass through most common materials.

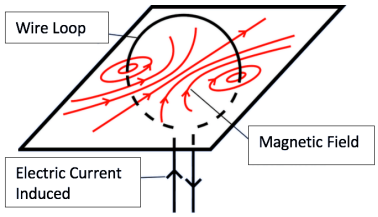
There are four basic principles for understanding electromagnetic theory. First, electric charges attract or repel each other with a force that is inversely proportional to the distance between them. Second, magnetic poles attract or repel each other like electric charges and exist in pairs. Third, and importantly, an electric current in a wire generates a circumferential magnetic field surrounding the wire. The direction of the magnetic field is perpendicular to the wire and in the direction of your fingers of your right hand curled around the wire with your thumb pointing in the direction of the current (Figure 1).

FIGURE 1. Magnetic field generated surrounding a wire conveying an electric current.



Fourth, and conversely, an electric current is induced in a loop of wire when moved towards or away from a magnetic field or a magnet is moved towards or away from it. In the current instance of HIFEM technology, a rapidly varying magnetic field induces an electric current in the target tissue (Figure 2).

FIGURE 2. A rapidly moving magnet induces an electric current.



In the use of HIFEM technologies for muscular sculpting, the rapidly moving magnet in the handpiece generates an electric current in tissue that depolarizes motor nerves resulting in muscular contractions. Magnetic field intensity delivered are up to 2.5 Tesla. Other applications are being investigated, including fat apoptosis and pelvic floor stimulation.

An important safety issue that needs to be addressed is the dosage of electromagnetic field being generated per treatment. The World Health Organization has established potential long-term effects of childhood leukemia from average magnetic field exposures in the 0.3 T range.[3]

As our laser, light, and energy-based device field evolves with new areas of research and treatments using novel applications, we should continue to emphasize the importance of rigorous research and long-term clinical trials.

References

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