MEDICAL RESURFACING METHODS

FOR MANY, the gold standard of facial rejuvenation treatments remains laser resurfacing. More ablative than so-called lunchtime procedures, the results of this treatment are quite dramatic: a laser resurfacing will typically rejuvenate the face and make it appear five to 10 years younger in a single treatment. While many would consider the 1990s as the heyday of laser resurfacings, a number of new technologies have recently become available, renewing both practitioners' and consumers' interests in this treatment modality.

Both traditional laser resurfacing treatments, achieved with CO2 or erbium:YAG lasers, as well as the innovative technologies now available, tend to be reserved to physicians. However, a therapist working in a medical spa, where a doctor offers these procedures, will be involved in the treatment. Informing patients about their treatment options, as well as pre- and postoperative care, comes to mind. Let's take a look at the technology, devices, and new developments that will affect the medical spa industry. ➛

by Ada Polla Tray

BEFORE (LEFT) AND AFTER (RIGHT) TREATMENTS WITH CO2 AND ERBIUM:YAG LASERS.

Laser resurfacing involves the use of ablative lasers to remove the top-most layer of skin (epidermis) and heat the layer under the epidermis (the papillary dermis).

Lasers: the basics

The word *laser* is an acronym for "light amplification by the stimulated emission of radiation." Laser light is monochromatic (composed of a single color/wavelength), coherent and collimated. After its absorption by a chromophore (the color part of a molecule), this light energy is transformed into thermal or mechanical energy before it interacts with the tissue. Selective, light-induced thermal or mechanical damage occurs with a wavelength that is specifically and well-absorbed by the targeted structure (the chromophore), and a pulse duration that is shorter than the thermal relaxation time of that target. Sufficient energy must be delivered to cause destruction of the target with minimal damage to the surrounding tissue.

Typically, lasers are discussed in terms of the following parameters:

1. Wavelength (nm, nanometers): Determined by the lasing medium, which is chosen based on the targeted chromophore. Although most lasers used in dermatology emit rays contained in the visible light and near infrared range of the spectrum (400 to 1,100 nm), known as the therapeutic window, some emit in the far-infrared range (2,000 to 11,000 nm), including most resurfacing lasers.

2. Pulse duration (ns, μs, ms, i.e. nano-, micro-, millisecond): The duration of each laser pulse (not relevant for continuous wave lasers). It is chosen based on the thermal relaxation time of the target.

3. Fluence (J/cm², Joules per centimeter square): The energy delivered per unit area. As the fluence increases, so does the destructive force of the beam. Depending on the laser used, the fluence will vary between 3 and 150 J/cm².

4. Irradiance (W/cm², Watts per centimeter square): The intensity of energy delivery. A high irradiance induces fast heating of the chromophore, or mechanical damage to it. Q-switched lasers have the highest irradiance (mega- to gigawatt output).

Lasers: selective thermolysis

Lasers used in dermatology were pioneered by Dr. Leon Goldman in 1963, with the use of the ruby laser to treat various cutaneous conditions. Twenty years later, R. Rox Anderson, M.D., and John A. Parrish, M.D., refined Goldman's work by developing the theory of selective photothermolysis, which states that laser light of a specific wavelength emitted during a specific pulse duration can destroy a target containing the adequate chromophore without damaging the surrounding tissue.

The key to selective thermolysis is the concept of thermal relaxation time. The thermal relaxation time of a mass is the time required for it to cool down to the ambient temperature after having been heated. For most targets, this time is determined by their size and shape, varying between 10 nanoseconds for a tattoo ink particle and 100 milliseconds for a hair follicle.

Selective photothermolysis suggests that if a mass is heated for a period shorter than its thermal relaxation time, there is not enough time for thermal diffusion to damage the surrounding tissue. Stated another way, if a target is heated for a period shorter than its thermal relaxation time, the heat and resultant damage (necessary for successful treatment) is confined to the target alone and the surrounding tissue remains unharmed.

Lasers for laser resurfacing

Laser resurfacing was one of the first uses for lasers in the dermatological setting. Laser resurfacing involves the use of ablative lasers to remove the top-most layer of skin (epidermis) and heat the layer under the epidermis (the papillary dermis). This causes both the elimination of surface imperfections (age spots, scars, fine lines and wrinkles), as well as collagen regeneration. As the wound caused by the laser heals, smoother and more even skin is revealed. This procedure requires anesthesia and postoperative care. Side effects, in particular hypopigmentation, are common. Typically, complete healing after a full-face laser resurfacing can take up to several months.

There are two types of ablative lasers used for resurfacing: the carbon dioxide (CO2) and the erbium:YAG (Er:YAG).

CO2 resurfacing

The first laser used for resurfacing treatments was a high-energy, rapidly scanned, continuous wave, carbon dioxide (CO2) laser, which had an invisible wavelength of 10,600 nanometers (nm). The rapidly-scanned laser beam delivered extremely short bursts of high-energy laser light to vaporize the undesired skin tissue one layer at a time by targeting the water in the skin.

The technology evolved from rapidly scanned, continuous wave lasers to ultra-pulsed lasers. Today, the best-known CO2 laser for resurfacing is the Coherent UltraPulse. Controlled energy pulses remove sun-damaged, aging skin, layer by layer, which stimulates the regeneration of healthy tissue, to produce smoother, fresher, younger-looking skin.

Most recently, Lumenis launched a newer version of the ultra-pulsed CO2 laser, the UltraPulse Encore. This newer device is comparable to the UltraPulse, but offers added versatility through the addition of a "softer" option that reduces the downtime associated with a laser resurfacing, and is comparable to a resurfacing performed with an erbium laser.

Erbium resurfacing

The high-powered Er:YAG laser produces energy in a wavelength that is more selectively absorbed by water than the CO2 wavelength (2,940 nm versus 10,600 nm). As such, most of the Er:YAG's energy is absorbed in the thin layer of the subcorneal epidermis (where water presence begins). The residual heat deposition and resulting side effects associated with CO2 lasers are thus minimized.

The Er:YAG laser is commonly used for skin resurfacing in patients who have superficial facial wrinkles, mild surface scars, or skin discolorations. The more selective absorption of the

BEFORE (LEFT) AND AFTER (RIGHT) TREATMENTS WITH CO2 AND ERBIUM:YAG LASERS.

The erbium:YAG laser is recommended for patients who have superficial facial wrinkles, mild surface scars, or skin discolorations.

2,940 nm wavelength means Er:YAG lasers are particularly effective in rejuvenating delicate areas such as the eye and mouth contours. Other body areas, such as the neck and hands, also may be considered for treatment with the Er:YAG laser. Skin rejuvenation with the Er:YAG laser offers the advantages of reduced redness, decreased side effects, and more rapid healing as compared to a CO2 laser resurfacing treatment. Most significantly perhaps, the typical hypopigmentation associated with a CO2 laser resurfacing is minimized with Er:YAG lasers.

The better known Er:YAG laser used for resurfacing treatments is the Sciton Contour laser, a high-powered, dual-mode, variable pulse 2,940 nm device.

Fractional resurfacing

More recently, a new treatment modality has emerged, representing a blend of ablative laser resurfacing and non-ablative laser treatments, namely fractional resurfacing. Like a CO2 or Er:YAG laser, fractional resurfacing is based on targeting water as the main chromophore.

A fractional laser treatment produces thousands of microscopic yet deep columns of tissue coagulation in the skin, known as microthermal

continues

BEFORE (LEFT) AND AFTER (RIGHT) THREE TREATMENTS WITH THE FRAXEL LASER.

The fractional resurfacing technique is safe for all skin types, including the darkest, as well as for tanned skin. It can also be used to treat photodamage in areas other than the face, including the chest, neck and hands.

treatment zones (MTZ). Just as important as the treated areas are the areas of skin a fractional resurfacing treatment leaves untouched. Indeed, for every MTZ the laser targets and treats intensively, the surrounding tissue remains unaffected and intact. This uninjured tissue allows for more rapid wound healing (the epidermis will heal in 24 hours) and minimization of visible scarring. Just like the more traditional laser resurfacing, a fractional resurfacing enables the removal of undesirable pigment and other photodamage lesions while stimulating long-term collagen remodeling.

This fractional treatment allows for an effective treatment with results quite comparable to those of a traditional CO2 resurfacing, but with much less downtime and side effects, and without the need for anesthesia or postoperative care (maximal efficacy for a minimal risk). An added benefit of this fractional resurfacing technique is that it is safe for all skin types, including the darkest, as well as for tanned skin. Furthermore, fractional resurfacing can successfully be used to treat photodamage in areas other than the face, including the chest, neck and hands.

The gold standard to date for fractional resurfacing is the Reliant Fraxel laser, a 1,550 nm laser powered by an erbium-doped glass.

Low-powered Er:YAG resurfacing

Another new development in the field of laser resurfacing is the emergence of lower-powered devices that have a more gentle, rejuvenating effect. Recently, Candela Corporation launched the SmoothPeel, a low-powered Er:YAG laser touted as an alternative to microdermabrasion and chemical peels. This device is based on the proven ablative capabilities of the 2,940 nm wavelength previously discussed. A treatment with this new low-powered Er:YAG laser consists of the removal of up to 25 microns from the skin's surface. Superficial photo-damage, fine lines, and age spots can be treated. Immediately post-treatment, the client's skin will look like he or she had a slightly aggressive peel or microdermabrasion treatment. Unlike the aftereffects of a more traditional Er:YAG resurfacing, there is no open wound, bleeding or postoperative care necessary.

Taking off the years

While facial rejuvenation treatments today most often involve non-ablative therapeutic modalities, laser resurfacing treatments remain the most effective and dramatic way of ensuring rejuvenation to take off five to 10 years. New technologies such as fractional lasers and low-powered Er:YAG devices have surfaced, which build on the success of traditional laser resurfacing performed with high-powered CO2 and Er:YAG lasers. As these new modalities emerge in the consumer press, estheticians in both spas and medical offices must be equipped to answer their clients' questions in a confident and educated manner. ■

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