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OPINION ARTICLE

21st-Century Alternatives to Classic Resurfacing Techniques☆

Nuevas técnicas alternativas al *resurfacing* clásico en el siglo XXI

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Conventional resurfacing with carbon dioxide (CO_2) laser therapy is highly effective for reversing the signs of skin photoaging. Improvements can be appreciated and are often spectacular even after a single session. They are also long-lasting,[1,2] as can be demonstrated on the basis of both clinical and histologic criteria.[3] However, after the initial boom of the mid-1990s many dermatologists and plastic surgeons began to lose their enthusiasm for this technique as they became aware of the considerable associated morbidity, the long recovery times, need for meticulous postprocedural care, and non-negligible risk of adverse effects. Fewer and fewer patients are willing to accept prolonged periods away from work and social life or to assume the discomfort and risk that accompany CO_2 laser therapy. As a result, other rejuvenation techniques have been developed. They sacrifice some degree of efficacy in the interest of safety and convenience but are at present generally better accepted by most patients. Grouped together under the heading of evolving approaches to therapies to reverse photoaging, these alternative treatments combine several techniques and are applied in a series of sessions for treatment and maintenance. Adverse effects are minimal and the improvements are more subtle, without sudden changes in the patient's appearance.

These gentler approaches to treating the signs of aging—such as changes in coloring and texture or the formation of wrinkles—are based on 2 concepts.[4] The first is the use of nonablative mechanisms that act on the dermis without damaging the epidermis, thus lowering the risk of adverse effects and minimizing the time until the patient can resume normal activity. The second is the use of fractional therapy, through which microscopic treatment zones are distributed in columns separated from each other by intact tissue; this system encourages rapid recovery and lowers risk.[4]

Experiments have shown that conventional nonablative lasers like those traditionally used to treat vascular lesions (pulsed dye, Nd:YAG [neodymium:yttrium aluminum garnet], and KTP [potassium-titanyl-phosphate] lasers) and infrared lasers with a wavelength of 1320 or 1450 nm are able to enhance collagen synthesis and decrease oxidative stress[5,6]; however, their clinical rejuvenating effect is minimal and they are little used for this purpose. My opinion is that these tools could be useful to complement other anti-aging treatments, such as the injection of botulinum toxin or fillers because they act on erythema and telangiectasia and attenuate color differences. Pulsed light therapy is particularly useful for such complementary purposes, especially when treating the neck and upper part of the chest, where it improves texture while also attenuating telangiectasis and pigmentation changes.[7] However, the effect on wrinkles is practically nil, so we cannot think of these techniques by themselves as true alternatives to classic resurfacing even when sessions are given in series.

Nonablative fractional laser therapy for photoaging is a step forward. The effect on wrinkles and changes in pigmentation and texture is moderate in this modality, in which the density of columns of thermal damage can be controlled and their depth adjusted according to the energy administered. Treatments are well tolerated and time away from work or social life is minimal. They are also safe, with minimal risk of adverse effects. Although appreciable results require several sessions (usually 3 to 6) and the improvement is not as great as that achieved with classic resurfacing, many patients prefer this alternative, which does not interfere with their routine and offers a high degree of safety. Another option that has proven useful is the combination of pulsed light and fractional nonablative laser at a wavelength

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of 1550 nm in the same session. When applied together, the effect of each treatment is enhanced, yet there is no increase in recovery time or adverse effects.[8]

In 2007, reports of the results of fractional ablative laser treatment began to appear. Initially CO_2 lasers were being used at a wavelength of 10 600 nm. Later, devices giving an Er:YAG (erbium-doped YAG) beam at a wavelength of 2940 nm were developed. The aim of these modalities was to approximate as closely as possible the response to traditional ''confluent'' ablative lasers (classic resurfacing) while significantly reducing recovery time, postprocedural discomfort, and the risk of adverse effects. In fractional techniques, a high percentage of skin remains intact, encouraging rapid recovery and lowering risk. Many studies have shown that the fractional ablative lasers are more effective than nonablative techniques,[9] in spite of higher associated morbidity. The new systems can probably be considered the true heirs of classic resurfacing, given that outcomes can even be equivalent to those achieved with traditional CO_2 laser therapy and, for patients willing to take a certain amount of time off to recover, the fractional ablative approach offers a powerful tool for obtaining clearly appreciable results in a single session.

The tolerability and efficacy of other approaches to resurfacing have also recently come under study. These methods include minimally ablative resurfacing using Er:YSGG (erbium:yttrium, scandium, gallium, and garnet) laser light at a wavelength of 2790 nm. This modality has a water absorption coefficient of 5000/cm^2, which falls between the coefficients of the Er:YAG (12 500/cm^2) and CO_2 (1000/cm^2) lasers. The ER:YSGG laser provides thermal stimulation and coagulation that cannot be achieved with the ER:YAG device without causing collateral damage and exudation—with the consequent need for a recovery time similar to that required after CO_2 laser therapy.[10] Another approach that has been described is the combination of fractional and continuous laser treatments in the same session. This approach achieves complete vaporization of the superficial epidermis with coagulation of the deep epidermis and fractional coagulation of the deep dermis; improvement is evident within an average of 6 days, when make-up can again be applied and routine social life can be resumed.[11]

Nonlaser modalities have also been used to rejuvenate photoaged skin. The latest radiofrequency devices not only encourage collagen contraction and remodelling—tightening the skin—but they also produce subtle improvements in texture. Some of these devices incorporate a laser beam or pulsed light to work more broadly on diverse effects of photoaging. More recently, the so-called fractional radiofrequency devices have begun to appear, offering both fractional ablative treatment and deep volumetric heat delivered to the dermis. Promising results have been reported for these devices in treating the effects of photoaging[12] and in correcting acne scars.[13] The effect on collagen has been confirmed histologically. Fractional radiofrequency therapy has also been combined with ultrasound to enhance percutaneous penetration of the active principles in treatments for photoaging and other conditions. All these systems carry minimal risk of adverse effects and recovery is nearly immediate. As the beneficial effects are moderate, several sessions must be given before benefits become noticeable.

Laser and radiofrequency are not the only modalities used to apply thermal energy at doses that are sufficient for achieving collagen remodelling. Another option, plasma skin regeneration technology, is based on the ionization of nitrogen gas by means of radiofrequency stimulation. In this system the nitrogen gas is converted to plasma—the fourth state of matter, in which electrons have been separated from atoms to form an electromagnetically unstable ionized gas able to transmit energy directly to the skin in pulses. As the local heating by plasma bursts does not require a chromophore, energy is delivered uniformly to the skin. This technology is nonablative, recovery is rapid, and the effects have been compared favorably to those of classic rejuvenation therapy with ablative confluent lasers.[14,15] Although this technique is little known and hardly used in Spain, it was approved by the US Food and Drug Administration for the treatment of facial wrinkles some years ago and the literature contains reports of beneficial effects on skin tone, texture, and coloring.

In spite of the vast literature on a great variety of skin rejuvenation techniques, it is not easy to draw conclusions as to the superiority of one over another. If we subscribe to the evidence-based practice of medicine, we must take note that few high-quality randomized controlled trials are available to help us decide which procedure is the safest and most effective. A 2009 Cochrane review on interventions for photodamaged skin found only limited evidence for the superiority of phenol peeling over CO_2 laser treatment of photoaged skin of the upper lip, although postprocedural discomfort was greater with the phenol treatment.[16] That review did not bring clear evidence to light to support the superiority of CO_2 laser therapy over Er:YAG laser therapy; nor did it consider the new techniques discussed above. General review articles on the subject nonetheless express the opinion that ablative laser therapy achieves superior results, even though nonablative and fractional technologies have become much more popular because they give acceptable results with fewer adverse effects.[17]

Practically speaking, our adoption of one type of treatment over another for routine use will be influenced by both the availability of the technology and the patient's expectations and willingness to undertake whatever skin rejuvenation option we might propose. Less aggressive techniques will be preferable for patients who cannot accept a recovery period of inactivity that can be fairly long and involve meticulous care of the treated skin. Patients who seek an easier recovery must be able to commit to multiple sessions at intervals of several weeks, however, as less aggressive approaches are delivered in series to achieve an effect that can be evaluated. The most useful therapies in these cases will probably be those that combine the application of light or radiofrequency energy along with neurotoxin treatment of expression wrinkles or fillers to replace loss of volume. Naturally, although such rejuvenating programs are highly effective and fairly well tolerated and safe, they are expensive. It will therefore be preferable to prioritize and treat only the aspect that concerns the patient most, in accordance with an acceptable risk of adverse effects.

In summary, we can conclude that fractional lasers (particularly ablative modalities), the new radiofrequency devices (combined or not with pulsed light or nonablative lasers), and the less-known plasma skin regeneration

systems are techniques that offer effective and safe alternatives to confluent CO_2 laser rejuvenation therapy. We should not forget, however, that classic resurfacing will continue to be the best choice for some patients. For classic resurfacing, the patient should be referred to one of the increasingly scarce specialists that still perform this procedure routinely, given that experience is the key to achieving an acceptable result.

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