Fractional Resurfacing Update

Kenneth Beer, MD

Interest in laser skin resurfacing has increased over the past few years. This resurgence of interest has been the result of newer resurfacing devices that have enabled physicians to deliver subablative pulses of laser light. These fractional laser devices allow the skin to repopulate without full epidermal or dermal eradication. Hybrid and tunable devices are also being introduced into the market, and these devices are expected to become more refined as experience with them increases.

Earlier in my career, I was an advocate of ablative laser resurfacing. I was influenced by the early laser gurus of dermatologic surgery, who swore that the procedure was the next big thing. At first, I used the CO_2 laser to treat perioral and full-face rhytides, with some impressive results. There was controversy about postoperative care, with the major issue being the use of occlusive or nonocclusive dressings. The number of patient visits required during the postoperative period made the procedure very time and labor intensive for conservative physicians like me; I personally would see my patients daily for the first 10 days postoperatively. Even when the best methodology was employed, postoperative erythema, hyperpigmentation, and infections (particularly herpetic) happened frequently, with occurrence rates approaching 100% (erythema), 37% (hyperpigmentation), and 7.4% (herpetic flare).[1] The amount of time required to care for patients combined with the complication rates dampened enthusiasm for CO_2 resurfacing, and physicians and their patients began to look for alternatives. Among the alternatives that seemed promising was the 2940-nm erbium:YAG resurfacing laser, which was billed as causing less scarring than other lasers. However, after several unimpressive devices were brought to market, many cosmetic dermatologists began to return to older, more predictable methods of resurfacing, including chemical peels.

Recently, however, there has been a resurgence of interest in laser resurfacing owing to the development of novel technologies that enable physicians to remove pixels of skin rather than erase the entire surface of the skin. The theory behind leaving islands of skin undamaged is that these islands will help to repopulate the adjacent wounded areas and allow the procedure to be performed with minimal downtime. At the present time, there are a few fractional resurfacing devices that I will consider: Fraxel®, Lux1540 Fractional™ Laser Handpiece, Affirm™ Anti-Aging Workstation, and UltraPulse® ENCORE™. When discussing these devices, it is important to realize that *Fraxel* is a brand of device, whereas *fractional* refers to the entire technology of the various lasers.

HOW FRACTIONAL LASERS WORK AND THE DIFFERENCES AMONG THEM

According to Narurkar,[2] "Nonablative fractional resurfacing involves the creation of microscopic islands of damage while allowing the majority of the epidermis to remain intact." Fractional resurfacing has been shown to treat photodamage in both facial and nonfacial skin.[3] Clinical trials have also demonstrated the efficacy of this procedure in the treatment of acne scars and hyperpigmentation.[4,5] It is highly likely that combinations of fractional and other lasers will be used to optimize outcomes for scarring, photodamage, and dyspigmentation; some of these hybrid devices are already being introduced.

The technology behind fractional resurfacing seems to be durable and likely to evolve. Different manufacturers use slightly different wavelengths. Palomar uses 1540 nm, Reliant uses 1550 nm, Cynosure uses 1440 nm, and Lumenis uses the UltraPulse ENCORE CO_2 laser with its ActiveFX™ technology to break up a CO_2 beam of light into smaller beamlets. The CO_2 wavelength used in this latter device is 12,600 nm and is absorbed mainly by water.

Dr. Beer is in Private Practice, West Palm Beach, Florida.

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The potential for CO_2 resurfacing without the long downtime and attendant risks associated with prior modalities is attractive to many surgeons who recall the outstanding skin tightening and long-term correction of perioral and periorbital rhytides attained with the older devices, such as the UltraPulse CO_2 laser. Although single-pass CO_2 resurfacing has been reported to have significantly fewer complications and to produce good results, this technique has not achieved significant popularity.[6] The newer UltraPulse ENCORE laser device fractionates the CO_2 laser into smaller beamlets that do not hit the skin in directly contiguous beams. Thus, although the laser removes the skin and heats the collagen, islands of spared epidermal stem cells enable a rapid healing process to occur. On an intuitive level, this approach seems to be ideal. In contrast with other fractional resurfacing devices, the UltraPulse ENCORE is a true CO_2 resurfacing instrument. Future versions will likely produce results consistent with those of the older CO_2 laser resurfacing devices, but without the concomitant risks or downtime. The UltraPulse ENCORE offers CO_2 laser resurfacing in a manner that is humane for both physician and patient.

Other types of fractional resurfacing devices do not use CO_2 and instead rely on infrared beams to wound the target tissue. The Fraxel utilizes a 1550-nm laser to target the water found in the cells. According to Reliant Technologies, Inc, depths of up to 1400 µm can currently be achieved with this device.[5] Hantash and Mahmood[7] report that the Fraxel device can deliver up to 3000 pulses per second, with each pulse creating a single microscopic treatment zone. These same authors note that avoidance of "pulse stacking and consequent bulk heating" helps to preserve the safety and technological advantage of fractional resurfacing, thereby enabling the nontreated islands of normal skin to repopulate the skin. Microscopic visualization of the microthermal zones reveals the histology that supports the significant advantage of fractional resurfacing.[7]

Whereas earlier versions of the Fraxel used a blue dye, tinting the patient's face, the new Fraxel SR1500 laser does not. In addition to spot size, laser source, and depth of penetration, there are differences among the lasers with respect to the energy output available and the degree of cooling. The Fraxel SR1500 allows for up to 70 J of energy and has a cooling device attached to it for added patient comfort. The increased discomfort that can result from added energy is partially offset by the increased spacing between spot sizes that occurs with increased energy levels. This means that some patients may actually have more discomfort with the Fraxel at lower fluences.

Using one power platform (the StarLux pulsed light and laser system) has enabled Palomar Medical Technologies, Inc, to develop a variety of laser handpieces that attach to the main base unit. This modular approach has the advantage of decreasing the space and capital tied up with laser and light devices and makes it easy for physicians to simply switch from an intense pulsed light (IPL) head to a fractional head to a deep infrared head depending on patient need. However, this approach has its own set of attendant problems and is associated with software and hardware glitches that have marred early iterations of the platform. These glitches, combined with the near constant need to negotiate warranties for each new head purchased, represent the main logistical issues associated with the StarLux system.

The StarLux system uses 2 spot sizes (10 and 15 mm); both handpieces are quite easy to use. Data released by Palomar reveal that at 100 mJ, the 10-mm spot handpiece is capable of penetrating to depths of 1 mm.[8] The 10-mm spot handpiece has approximately 100 microbeams per cm^2, and the 15-mm spot handpiece has 320 microbeams per cm^2.

The fractional handpiece Harmony® is a 2940-nm erbium:YAG laser. As with the StarLux system, Harmony can be placed onto a platform that also uses a variety of other handpieces. The advocates of the Harmony laser believe that it delivers fractional resurfacing in a clinically meaningful way without significant downtime. As is common with other fractional resurfacing devices, a series of treatments with this laser device is necessary to achieve optimal outcomes.

Some newer devices combine various wavelengths for synergistic benefits. For instance, the Affirm device uses a 1440-nm fractionated beam, with another wavelength at 1320 nm. This offers a theoretical advantage by affecting different layers of the skin to stimulate concurrent rejuvenation without causing significantly increased injury. Other hybrids utilize erbium:YAG and CO_2 or have tunable erbium:YAG sources. These types of combinations and variable wavelength lasers hold a great deal of promise; I believe that we will see more of them in the future.

CONCLUSIONS

Indications for fractional resurfacing include skin resurfacing, treatment of acne scars, and dyspigmentation. There are ample data to demonstrate both safety and efficacy for early versions of this technology. Fractional resurfacing may also be used to enhance drug delivery and to treat actinic keratoses or early skin cancers. Each product in the present generation of lasers has its own strengths and weaknesses, and as experience with each increases, the relative merits and shortcomings of each technology will become apparent. I believe that fractional laser resurfacing is

a significant advance and is here to stay. I am looking forward to further clinical trials and histologic studies that will help these devices evolve.

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