Initial Experience With a Yellow Diode Laser

The Iridex 577-nm offers more efficiency, less collateral tissue damage, and greater comfort for the patient.

BY JONATHAN D. WALKER, MD

I was a bit skeptical when I was given the chance to try out the new yellow laser by Iridex Corporation (Mountain View, CA). I had used dye yellow lasers in the past, and I was not sure that a newer version would offer much benefit beyond a typical 532-nm green laser. Because every other piece of technology that surgeons use today has improved dramatically, however, I decided it was worth trying the laser.

ADVANTAGES OF THE YELLOW WAVELENGTH

If you have not used a yellow-wavelength laser, there are some advantages worth noting. First, because of differences in absorption, yellow requires less power to obtain the same clinical response relative to green.[1] Second, yellow has increased uptake by hemoglobin compared with green, which allows the former to treat microaneurysms with less damage to the underlying retinal pigment epithelium (RPE).[2] Both of these advantages are readily apparent with the new laser.

The 50-µm spot is razor sharp and allows for very precise focal treatment of diabetic macular edema. If the patient has extensive retinal thickening or the media are hazy, there is more collateral damage to the RPE, but in most cases, it is possible to do an almost "no-touch" focal procedure with treatment limited to microaneurysms alone. It is important to recognize, however, that no clinical trial has been undertaken to determine if the yellow wavelength is associated with long-term advantages. Two short-term trials have shown yellow's equivalence to green, and one favored yellow.[3-5] Still, the ability to administer treatment with minimal scarring would appear to be an advantage, since scars expand over time and patients are living longer. There is clearly renewed interest in the utility of the yellow wavelength, given that four other companies now market a yellow laser (Ellex Medical, Adelaide, Australia; Carl Zeiss Meditec, Inc., Dublin, CA; Lumenis Ltd., Santa Clara, CA; and Quantel Medical, Bozeman, MT). None of these others has the Iridex's capability to perform the patented MicroPulse treatment, as discussed later.

The Iridex laser can also produce pulse durations as short as 0.01 seconds. Combined with yellow laser's lower power requirement, the shorter treatment time means that patients are more comfortable than during treatment with the older green lasers. I am often able to perform panretinal photocoagulation without the use of peribulbar anesthesia on patients who require a block for treatment with a green laser. Moreover, the repeat mode on the laser can be set with repetitions as rapid as 10 milliseconds. Although the repetition rate of 10 milliseconds is far too fast for a traditional treatment, it is useful for the "painting" approach to MicroPulse treatment suggested by Luttrell et al.[6] Note that the short duration and rapid-repeat mode is not as fast as a programmable pattern laser (manufactured by OptiMedica Inc., Santa Clara, CA; Carl Zeiss Meditec, Inc.; and Quantel Medical). Those lasers may also have a greater advantage as far as patients' comfort. Programmable lasers have no MicroPulse capability, however, and only Quantel's platform has a yellow wavelength.[7,8]

Another advantage of the yellow wavelength is that it seems to penetrate a vitreous hemorrhage much easier than green. The increased uptake by hemoglobin does not make the yellow wavelength harder to use through a hemorrhage. I can detect a clinically apparent change in the retina through a dense hemorrhage more easily than with green wavelengths. This is particularly helpful in eyes that have a hemorrhage blocking my view of a retinal tear; the yellow wavelength makes it easier for me to perform a complete retinopexy through the hemorrhage without the need to resort to cryotherapy. The yellow wavelength is also helpful when performing panretinal photocoagulation on diabetic patients who have a vitreous hemorrhage

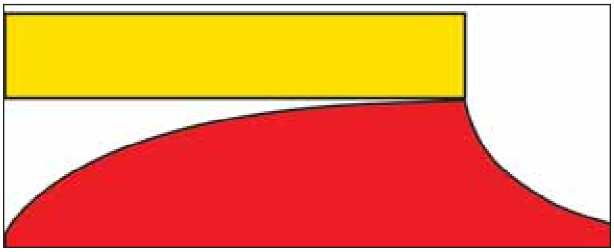


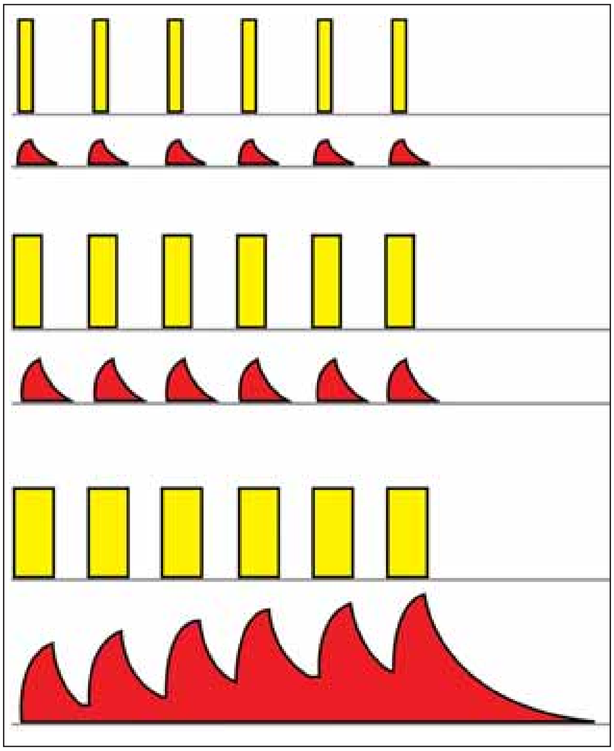
Figure 1. A schematic of the temperature rise associated with the application of continuous-wave laser energy. The yellow bar represents the duration of the laser pulse, and the red represents the rise and fall of the temperature of the treated tissues.

and want to avoid surgery. In addition, Rosen pointed out that the yellow wavelength allows the use of a red-free filter during treatment. This facilitates the identification of the fovea, and it also highlights microaneurysms, which can make treatment easier and assists residents who are learning to apply focal laser energy.[9]

I like the ease of positioning the wireless foot pedal, but I am more appreciative of my ability to adjust the power setting with paddles on each side of the main pedal. Another perk is the option of having the aiming beam transiently switch off as the laser is activated. It allows me to closely monitor the clinical change that is occurring without any backscatter from the aiming beam. This is particularly useful when I am trying to achieve a very subtle clinical response, such as during a focal and grid treatment using the techniques recommended by the Diabetic Clinical Research Network.[10] If you have come to find laser procedures tedious, the Iridex system may rekindle your enthusiasm by allowing you to perform a very nuanced treatment to optimize the patient's outcome.

MICROPULSE

The Iridex yellow laser can perform a MicroPulse treatment,[11] which involves delivering only a fraction of the requested power during the duration of a burn. To do so, the system delivers laser energy in pulses rather than continuously. The duration of these MicroPulses is determined by the duty cycle setting (ie, the percentage of time that the pulses are actually delivering laser power relative to the total time of the exposure; Figures 1-2). The pulsing keeps the temperature from building up in the same way it would with a continuous wave. Pulsing also produces a gentle subclinical effect without creating a visibly identifiable burn. This approach is believed to create a very localized treatment effect (eg, warming only the RPE without affecting the underlying choroid or overlying retina).[11]



(Figures courtesy of Iridex Corporation.)

Figure 2. A schematic of the MicroPulse laser. The yellow bars represent the effect of "slicing" up the continuous-wave laser energy into small segments, with the wider bars representing larger duty cycles (the laser is on for a greater percentage of the duration of the exposure). Note that the temperature in the tissue can be finely controlled to create separate elevations or gradually converging and increasing elevations, depending on the duty cycle setting.

A number of peer-reviewed publications have suggested that MicroPulse treatment using the 810-nm infrared laser can effectively address macular edema from different causes without creating any apparent damage in the RPE.[6,11-16] (Figure 3 is a representative case.) However, the technique has not been studied in large, long-term controlled trials in the same way that the traditional laser has been studied. Still, I have been using this approach for several years, and my findings are consistent with the literature. The effect of MicroPulse seems to be weaker compared with more traditional treatment, and the clinical response often takes a few months longer to achieve. Nevertheless, I find it gratifying to perform a laser treatment and watch the edema decrease with no apparent scarring. If MicroPulse fails, you can always perform a standard treatment and/or intravitreal therapy.

It is currently unknown if MicroPulse using the 577-nm wavelength is clinically equal to 810-nm treat-

(Images courtesy of Drs. N. Pasechnikova, S. Saksonov, and S. Suk.)

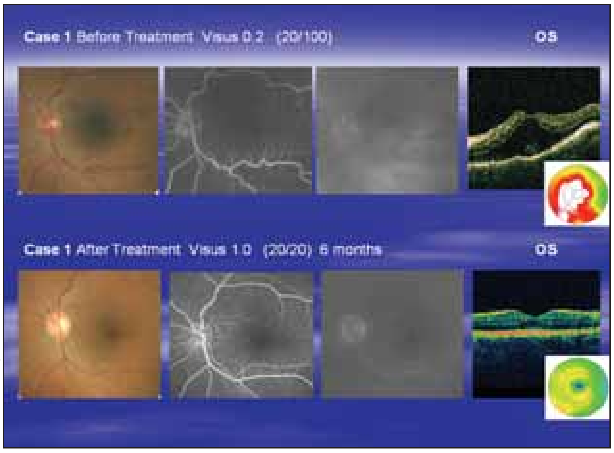


Figure 3. An example of a branch retinal vein occlusion treated with the 577-nm MicroPulse laser. Pretreatment images and optical coherence tomography demonstrate macular edema in an eye with a visual acuity of 20/100. Six months after treatment, there is regression of the edema with visual recovery to 20/20 and no clinical or angiographic evidence of laser burn damage.

ment, but preliminary work suggests that the two wavelengths are similar. If 577-nm MicroPulse proves effective, the Iridex unit will allow physicians to perform both standard and MicroPulse treatments without the need for different lasers. The real utility will be if it can be shown that nondamaging MicroPulse treatment, perhaps in combination with selective focal treatment, can help minimize the number of intravitreal injections required by patients with center-involving macular edema.

MicroPulse is not the only approach to subthreshold laser treatment. For instance, Ellex Medical has developed a technique using a Q-switched 532-nm laser to deliver a low-powered pulse lasting 4 nanoseconds. Preliminary data suggest that this approach may be effective against macular edema, but no peer-reviewed study has been published.[17] Another laser delivery system that bears mentioning is the navigated green laser photocoagulator (Navilas; OD-OS Inc., San Francisco, CA). With this device, the surgeon chooses the lesions to be treated using fundus images. Then, the laser tracks and targets the lesions, allowing a high degree of accuracy in the treatment. Because the system also uses a retinal imaging system to deliver the treatment, no slit lamp or contact lens is required.[18]

CONCLUSION

Whether or not you are looking for a new laser, you may want to consider trying the IQ 577. It produces less collateral damage than a traditional green-wavelength laser during the treatment of macular edema, and panretinal photocoagulation is more efficient and less painful. Media opacities are also less problematic. If MicroPulse treatment using 577 nm is proven to be as effective as 810 nm, the laser will be invaluable.

In the business world, capital improvements are made with the intention of generating greater revenue. That is not an option in the ophthalmic world: we will get the same reimbursement regardless of the color laser that we use. Even so, it is profoundly rewarding to provide patients with the least invasive, most state-of-the-art care possible. For this reason alone, it is worth testing potential improvements in modern laser technology. ■

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