Multicolor Scan Laser Photocoagulator Provides Efficiencies in the Clinic

The MC-500 Vixi laser is capable of any combination of red, green, and yellow wavelengths.

BY EVANGELIA PAPAVASILEIOU, MD, FEBOPHTH;
AND SOM PRASAD, MS, FRCSED, FRCOPHTH, FACS

Pattern scanning lasers, first introduced in ophthalmology during the previous decade, are designed to deliver single laser spots or multiple spots in preplanned array patterns to the retina for the treatment of a variety of pathologic conditions. These devices can save time for the clinician, streamline patient flow for the retina practice, and reduce discomfort from long laser sessions for the patient.

A second-generation multi-wavelength laser photocoagulator system, the MC-500 Vixi Multicolor Scan Laser Photocoagulator (Nidek Co. Ltd.) was introduced at last year's American Society of Retina Specialists meeting in Boston. The laser received US Food and Drug Administration clearance in August 2011 and is now available worldwide.

This pattern scan laser allows the practitioner to select from among 3 wavelengths: 532 nm green, 577 nm yellow, and 647 nm red, as well as combinations of any 2 or all 3 wavelengths simultaneously. This capability enables the user to select the necessary color or combination of colors to increase efficiency of treatment for a specific indication. We have had the opportunity to use this new laser for all forms of retinal treatments for several months, and we report our initial experience here.

MULTIPLE WAVELENGTHS

The Vixi is the only pattern scan laser that allows selection of multiple wavelengths. The most commonly employed wavelength in vitreoretinal practice is 532 nm green, used for treating retinal pathologies with panretinal

Figure 1. The laser in clinical use. It is a compact unit with a small footprint.

photocoagulation. The 577 nm yellow laser is minimally absorbed by xanthophylls and well absorbed by oxygenated hemoglobin, making it the wavelength of choice for lesions close to the macula. Good results with dye lasers operating at this wavelength have been reported.[1] Krypton lasers producing the 647 nm red wavelength have historically been used for photocoagulation of deep choroidal pathology.

The combination of the three wavelengths in one versatile machine with a small footprint (Figure 1) allows the clinician to provide therapy options appropriate for the patient's pathology. The laser also allows the use of these multiple wavelengths in a variety of grid patterns.

The MC-500 Vixi includes eight preprogrammed scan patterns with a memory function for up to 14 patterns (Figure 2). The available patterns include a single spot,

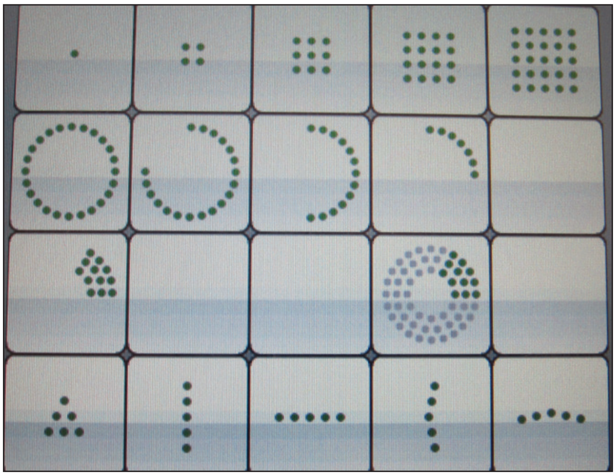

Figure 2. Various preprogrammed scan patterns are available from the touch-screen control unit.

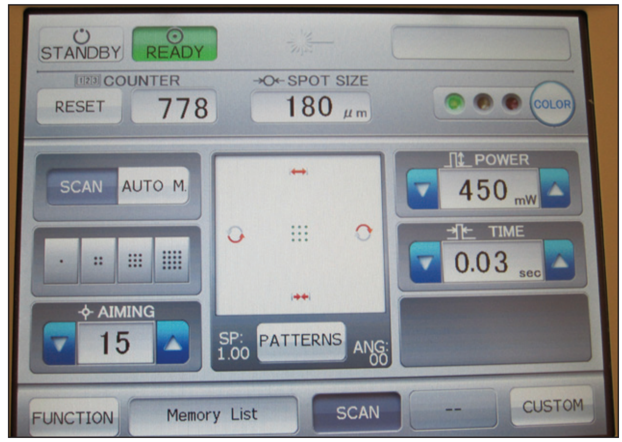

Figure 3. All laser parameters can be rapidly adjusted from the touch screen console.

squares (from 2-by-2 to 5-by-5 spots), a circle, arcs (of one-quarter, one-half, or three-quarters of a circle), a triple arc, a macular grid, a triangle, a line, and a curve.

The macular grid pattern can be used, for example, for treatment of the periphery of the macula in quadrants, with a fixed inner diameter and spot sizes ranging from 100 to 200 µm. The pattern can also be rotated in increments of 15° using an LCD touch screen (Figure 3). The 4 most frequently used scan patterns can be saved and recalled from the LCD menu.

The scan spot size is continuously variable from 50 to 500 µm in single mode and from 100 to 500 µm in scan and automanipulation mode. The actual spot size on the retina changes depending on the laser contact lens used.

Spot spacing can be adjusted with the touch screen. For grid photocoagulation, we prefer 2-spot spacing, while for panretinal laser we prefer 1-spot spacing. Continuously variable size adjustment enables the surgeon to compensate for changes due to laser contact lens selection.

The single-spot mode is used in conventional laser treatments, and the automanipulation mode can be used to deliver repeated laser emissions with variable internal times and conventional coagulation settings in a selectable scan pattern. The automanipulation mode allows the surgeon to continue laser emission while confirming spot placement. The scan mode is used for repeated laser emission with a fixed interval time, high power, and instantaneous speed.

PRACTICAL EXPERIENCE

In our experience, this laser saves time by requiring fewer sessions, consumes less energy, and provides more versatility than conventional models. It allows us to employ rapid and optimally powered laser emission for laser photocoagulation with a selection of colors and scan patterns. Laser output can be limited to a single wavelength or modulated to a combination of colors for specific treatments. It is intended to be used in ophthalmic surgical procedures, including retinal and macular photocoagulation, iridotomy, and, for our glaucoma colleagues, trabeculoplasty.

The chorioretinal damage and therapeutic effects of different laser wavelengths are similar, but each wavelength has unique absorption and transmission characteristics that makes it desirable for a particular option. The MC-500 Vixi enables efficient photocoagulation even through opaque media. In eyes with cataract, better penetration is achieved with the yellow wavelength compared with green. In eyes with retinal hemorrhage, better penetration is achieved with the red wavelength. In case of accidental hemorrhage during treatment, the clinician can switch rapidly to the red wavelength to cauterize the bleeding vessel.

Nagpal and colleagues[2] reported that pattern scan laser treatment was less time-consuming and less painful for the patient compared with single-spot 532-nm solid-state green laser. Also, pattern scan laser showed less collateral damage and similar regression of retinopathy compared with a single-spot 532-nm solid-state green laser.

For laser eye surgery near the macula, 577 nm yellow is the color of choice. Hemoglobin absorbs yellow light more than other colors, and 577-nm lasers are more effective than any other wavelength for sealing abnormal blood vessels while doing minimal damage to the macula. The yellow wavelength is safer in locations where the inner choroid is heavily pigmented (for instance, over a large choroidal vessel), reducing the risk of hemorrhage. Joondeph and colleagues[3] used 577 nm yellow to treat retinal macro-aneurysms and reported resolution of hemorrhage, exudates, edema, and serous macular detachment.

Clinical trials have shown that 577 nm yellow is less destructive than green, reducing temperature elevation but still achieving therapeutic goals and preserving visual sensitivity as measured by microperimetry. No controlled clinical trials have demonstrated the clinical advantage of 1 laser wavelength over another in conventional suprathreshold retinal photocoagulation, but dye lasers have been used to exploit the 577 nm yellow peak of oxyhemoglobin to improve the comfort and convenience of standard clinical retinal photocoagulation. Yellow 577 nm laser light provides excellent lesion visibility, low amounts of intraocular light scattering and patient pain, and high choriocapillaris absorption for more uniform effects in patients with light or irregular fundus pigmentation.

Studies have found that differences in efficacy of the resorption of hard exudates, visual outcomes, and resolution of focal diabetic macular edema between different types of laser were not statistically significant, but green laser can lead to submacular fibrosis or choroidal neovascularization.

Krypton 647 nm red lasers are typically used for treatment of deeper choroidal leakage and have less tissue penetration. This wavelength can be used in retinal vascular proliferative diseases and chorioretinal diseases associated with exudative manifestations.[4,5] The 647 nm red krypton laser light is not absorbed by the hemoglobin in the retinal hemorrhage or by the macular luteal pigment xanthophyll, and it is transmitted into the choroid, allowing treatment within the macular zone with less damage to the internal retinal elements than would be seen with other wavelengths.[6]

In cases of subretinal neovascular membrane, therefore, krypton red can be the treatment of choice. Feeder vessel photocoagulation with krypton red laser may also be considered as a treatment option for subfoveal choroidal neovascularization (CNV) secondary to age-related macular degeneration (AMD).[7] Moreover, in cases of retinal angiomatous proliferation (RAP) stage 3, which includes CNV as well as retinal choroidal anastomosis, krypton laser could be the potential treatment of choice.[8] In this subtype of neovascular AMD with particularly bad prognosis, this treatment could lead to anatomical closure of the vascular complex and eliminate the risk for development of tears in the retinal pigment epithelium.[9] However, it may have the disadvantage of requiring more retreatments compared with 532 nm green.

With the Vixi we can start treatment with 1 color and continue it with another. The laser is flexible enough to be used in almost all clinical cases. The automanipulation and scan modes allow mode selection appropriate for specific pathologies.

In addition to conventional single spot delivery, the scan capability allows a wide range of multicolor laser pattern deliveries. The laser can be used with existing slit lamps, transforming them into a stage for scanning laser treatments. It can also be provided in combination with YAG laser and an indirect ophthalmoscope. All units incorporate the Safety Optics with Low Impact on Cornea (SOLIC) optical design, which ensures low energy density on the cornea and lens even with large spot sizes.

The color LCD touch screen has an intuitive menu clearly indicating scan patterns and photocoagulation data. Ten sets of photocoagulation data (including color, power output, emission time, and interval time) applied to various clinical cases can be registered, and this can be helpful especially for repeated treatments and for patients participating in clinical trials. The laser also has a convenient power foot switch and is available with both front and rear dual ports for improved cable management. This solid-state laser provides longevity, space saving, and reduction of power consumption by 60% compared with the previous model.

CONCLUSION

The MC-500 Vixi is an extremely flexible and user-friendly technology. Although we have 3 different laser delivery systems in our retinal treatment clinic suite, this is the laser we now use for most of our cases because of its ease of use, the ability to change wavelengths on the fly, and the versatile patterns that can be adjusted intuitively. ■

Evangelia Papavasileiou, MD, FEBOphth, is a Vitreoretinal Fellow with the Wirral University Teaching Hospital NHS Foundation Trust, United Kingdom. She reports no financial relationships relevant to this article.

Som Prasad, MS, FRCSEd, FRCOphth, FACS, is a Consultant Ophthalmologist with the Wirral University Teaching Hospital NHS Foundation Trust, United Kingdom. He is a consultant for Bausch + Lomb, Bayer, and Nidek, and has also received travel reimbursements and/or advisory board fees from Alcon, Novartis and Allergan. Dr. Prasad can be reached via email at sprasad@rcsed.ac.uk.

1. Gupta V, Gupta A, Kaur R, Narang S, Dogra MR. Efficacy of various laser wavelengths in the treatment of clinically significant macular edema in diabetics. *Ophthalmic Surg Lasers.* 2001;32(5):397-405.
2. Nagpal M, Marlecha S, Nagpal K. Comparison of laser photocoagulation for diabetic retinopathy using 532-nm standard laser versus multispot pattern scan laser. *Retina*. 2010;30(3):452-458.
3. Joondeph BC, Joondeph HC, Blair NP. Retinal macroaneurysms treated with the yellow dye laser. *Retina*. 1989;9(3):187-192.
4. Khairallah M, Brahim R, Allagui M, Chachia N. Comparative effects of argon green and krypton red laser photocoagulation for patients with diabetic exudative maculopathy. *Br J Ophthalmol.* 1996;80(4):319-322.
5. Olk RJ. Argon green (514 nm) versus krypton red (647 nm) modified grid laser photocoagulation for diffuse diabetic macular edema. *Ophthalmology*. 1990;97(9):1101-1112; discussion 1112-1113.
6. Yannuzzi LA, Shakin JL. Krypton red laser photocoagulation of the ocular fundus. *Retina*. 1982;2(1):1-14.
7. Shiraga F, Ojima Y, Matsuo T, Takasu I, Matsuo N. Feeder vessel photocoagulation of subfoveal choroidal neovascularization secondary to age-related macular degeneration. *Ophthalmology*. 1998;105(4):662-669.
8. Stoffelns BM, Kramann C, Schoepfer K. Laser photocoagulation and photodynamic therapy (PDT) with verteporfin for retinal angiomatous proliferation (RAP) in age-related macular degeneration (AMD). [Article in German] *Klin Monbl Augenheilkd.* 2008;225(5):392-396.
9. Krieglstein TR, Kampik A, Ulbig M. Intravitreal triamcinolone and laser photocoagulation for retinal angiomatous proliferation. *Br J Ophthalmol.* 2006;90(11):1357-1360.