

EXPLORING TWO PHOTOCOAGULATION MODES FOR DME

Continuous-wave and subthreshold capabilities in a single laser.

BY CAESAR K. LUO, MD, AND MELISSA D. NEUWELT, MD



Continuous wave (CW) laser photocoagulation has been a mainstay in the treatment of exudative retinopathies and chorioretinopathies for decades. However, its use has waned due to increasing understanding of CW-induced

expansive tissue destruction¹ and resultant scotoma, as well as the advent of injected intravitreal pharmacologic therapies.

In recent years, subthreshold (ST) laser therapy has gained popularity due to its safety profile, ease of laser application, and effectiveness in pathologies involving the fovea. Instead of a single exposure, the ST signal consists of a train of brief subpulses, each subpulse with a duration on the order of tens to hundreds of microseconds. This pulsed structure reduces thermal injury to the retina while inducing outer retinal metamorphosis and metabolic activity.²

Green (532 nm) CW laser photocoagulation has been widely used, both in the office setting and intraoperatively. Recent series have discussed the efficacy of green ST laser.²⁻⁴ Green ST laser has been reported to be effective in numerous

TABLE 1. PATIENT DEMOGRAPHICS

Age (years)	54.6 ± 7 (SD)
Sex	69% male
Ethnicity/race	25% white 31% black 38% Latino 9% other
Eye(s) treated	46% left 31% right 23% both
Abbreviation: SD, standard deviation	

pathologies, including diabetic macular edema (DME), central serous chorioretinopathy, age-related macular degeneration, retinal vein occlusion, and radiation retinopathy.

The Smart532 (Lumenis) is a novel photocoagulator that emits both CW and ST (SmartPulse) laser signals. In an exploratory study, we examined the safety and efficacy of these two treatment modes in eyes with clinically significant DME.

EXPLORATORY STUDY

In half of the cases in our study, the Array LaserLink (Lumenis) pattern delivery system was used to deliver multiple spots. In the other half of the cases, the laser was delivered in single spots.

Institutional review board approval was obtained, and informed consent was signed by all participants. Thirteen patients with DME were recruited from July 29th to August 5th, 2016 (Table 1). Three patients were treated in both eyes with a 1-week interval between the two eyes. Treatment procedures were performed by one of the authors.

Sixteen eyes were treated in one of the following treatment groups:

- CW mode, single spot delivery (extrafoveal)
- CW mode, pattern delivery (extrafoveal)
- ST mode, pattern delivery (sub- or extrafoveal)
- ST mode, single spot delivery (sub- or extrafoveal)



AT A GLANCE

- ST laser therapy reduces thermal injury to the retina while inducing outer retinal metamorphosis and metabolic activity, which is likely why it has become more popular lately.
- The safety and efficacy of a novel photocoagulator that emits both CW and ST laser signals was examined in a recent exploratory study.
- The photocoagulator achieved the desired laser photocoagulation with an excellent safety profile at 2 weeks after treatment.

TABLE 2. LASER PARAMETERS

	CW Mode (n=8)		ST Mode (n=8)	
	Single Pulses (n=4)	Multiple Pulses (n=4)	Single Pulses (n=4)	Multiple Pulses (n=4)
Exposure (msec)	100-150	50	50-200	20-50
Interval (msec)	NR	NR	300	NR
Pattern	NR	2 x 2	NR	3 x 3 or 5 x 5
Spacing	NR	0.25-0.50	NR	0.25-1.50
Spot Size (μm)	50-100	150	100-200	100
Power (mW)	70-120	85-110	240-360	180-280
Frequency (Hz)	NR	NR	500	500
Duty Cycle (%)	NR	NR	5	5

Abbreviations: CW, continuous wave; NR, not relevant; ST, subthreshold

Pathology site and extent dictated the operational mode and method of delivery: CW mode was employed for extrafoveal lesions only; ST mode could be employed for subfoveal or extrafoveal lesions; single spot delivery was preferred for treatment of focal and isolated microaneurysms; the pattern delivery system was used in eyes with diffuse macular edema or diffuse microaneurysms.

Before treatment, baseline ancillary testing was performed, including BCVA, Humphrey visual field, spectral domain optical coherence tomography (Heidelberg), and fluorescein angiography (Heidelberg). Eyes were then treated in CW or ST mode.

In CW mode, the power was set as follows. All other laser settings (spot size, exposure duration, etc.) were set according to the pathology, the distance from the fovea, and the preference of the operating surgeon. Then a titration procedure was employed in a peripheral location outside the area of edema; power applied starting at 50 mW and then gradually increased, until a gray-white endpoint was obtained. This value was then used throughout the procedure.

In ST mode, a titration procedure was performed first using the laser in the CW mode, as described above. Then the laser was switched to ST mode (duty cycle 5%), and the power was multiplied by a factor of three (up to a maximum power level of 400 mW). This value was then used throughout the procedure. Laser settings used are summarized in Table 2.

RESULTS

Two weeks after treatment, 11 patients returned for follow-up examination. The three patients who were treated bilaterally returned after 3 weeks for examination of both eyes. One patient did not show up for the follow-up examination due to an unrelated hospitalization.

In the eight eyes treated in CW mode, fluorescein angiography and red-free images demonstrated extrafoveal hypofluorescence, as expected (Figure 1). No visible focal



Figure 1. Imaging of an eye treated in CW mode, before treatment (A) and 2 weeks after treatment (B). The eye was diagnosed with extrafoveal diffuse microaneurysms inferior and temporal to the fovea. Sixty laser spots were delivered in a 2 x 2 pattern. On red-free images (left), laser burns are visible. OCT (right) shows no significant changes.

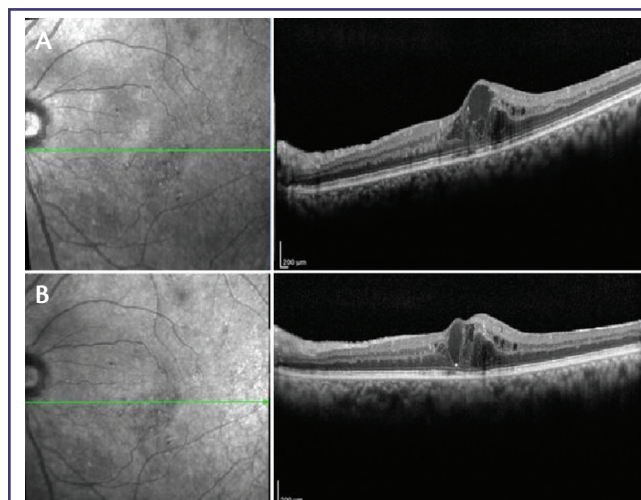
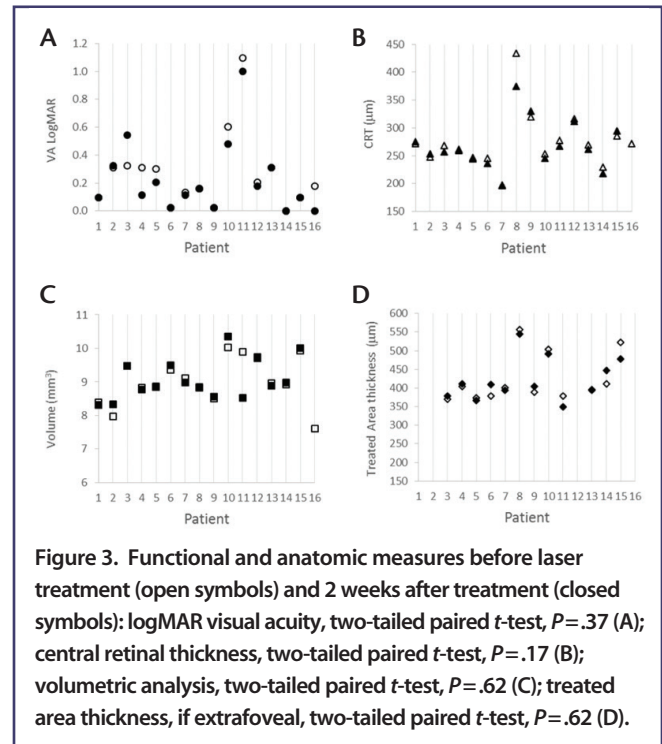


Figure 2. Imaging of an eye treated in ST mode, before treatment (A) and 2 weeks after treatment (B). The eye was diagnosed with subfoveal cystoid macular edema. Seventy-two laser spots were delivered in 3 x 3 patterns. On red-free images (left), no laser burns are visible. On OCT (right), central retinal thickness decreased from 434 to 375 μm.

laser hypofluorescence was observed for any of the eight eyes treated in ST mode, thus demonstrating the subthreshold nature of this type of treatment (Figure 2).

On average, logMAR visual acuity, volumetric analysis, central foveal thickness, and edema of extrafoveal-treated areas showed no statistically significant changes compared with baseline (Figure 3). Fourteen of the 15 examined eyes showed no changes in visual field. In one eye (CW group), a new inferior field defect, 1 disc diameter in size, was



identified at the follow-up. This defect did not correspond to the area of laser treatment, in the temporal macula. Other visual field results showed no changes from baseline.

CONCLUSION

The Smart532 with Array LaserLink achieved the desired laser photocoagulation with an excellent safety profile at 2 weeks after treatment. The system was efficient and easy to use, and it has novel technologies to maximize operator performance, including a micromanipulator joystick and a heads-up display. We plan to collect data at 3-month follow-up to further elucidate the effectiveness of this treatment platform. ■

1. Schatz H, Madeira D, McDonald HR, et al. Progressive enlargement of laser scars following grid laser photocoagulation for diffuse diabetic macular edema. *Arch Ophthalmol*. 1991;109:1549-1551.
2. Yu AK, Merrill KD, Truong SN, et al. The comparative histologic effects of subthreshold 532- and 810-nm diode micropulse laser on the retina. *Invest Ophthalmol Vis Sci*. 2013;54(3):2216-2224.
3. Vujosevic S, Martini F, Longhin E, et al. Subthreshold micropulse yellow laser versus subthreshold micropulse infrared laser in center-involving diabetic macular edema: morphologic and functional safety. *Retina*. 2015;35(8):1594-1603.
4. Pei Pei W, Shi-Zhou H, Zhen T, et al. Randomised clinical trial evaluating best-corrected visual acuity and central macular thickness after 532-nm subthreshold laser grid photocoagulation treatment in diabetic macular oedema. *Eye (Lond)*. 2015;29(3):313-321.

Caesar K. Luo, MD

- private practice at Progressive Vision Institute in Pottsville, Pa.
- financial disclosure: research support and speaker for Lumenis
- caesarluo@pvi-vision.com

Melissa D. Neuwelt, MD

- private practice at Progressive Vision Institute in Pottsville, Pa.
- financial interest: none acknowledged
- melissaneuwelt@pvi-vision.com