

# SubLiminal Subthreshold Laser Versus Photodynamic Therapy

Yellow SubLiminal laser has a more beneficial effect on visual acuity compared with half-dose photodynamic therapy.

BY LIHTEH WU, MD



I was part of the Pan American Collaborative Retina Study (PACORES) that compared yellow SubLiminal laser with photodynamic therapy (PDT) in eyes with chronic central serous chorioretinopathy (CSCR) (unpublished data). CSCR is characterized by choroidal hyperpermeability, pigment epithelial detachments, and retinal neurosensory detachments. Many patients experience spontaneous resolution, but in some patients, the disease becomes chronic with ensuing visual loss.

For these patients, the standard of care has been to treat with verteporfin (Visudyne; Bausch + Lomb) PDT. However, PDT has some adverse effects that include a transient reduction of macular function, retinal pigment epithelium atrophy, choroidal nonperfusion, and even secondary choroidal neovascularization. In the hopes of reducing the iatrogenic effects of PDT, investigators from Taiwan decided to compare PDT protocols in improving BCVA and eliminating subretinal fluid using half-dose, or half-fluence, of laser light.<sup>1</sup>

Despite these measures, the choroidal hypoperfusion still occurred.

The SubLiminal laser mode delivers energy in succeeding train of very short microsecond pulses, with alternative “on” and “off” times that have led to the duty cycle concept. A low duty cycle eliminates iatrogenic damage from laser photocoagulation because the power on and power off times selected allows the tissue to cool off during the laser treatment (Figure 1).

The ideal SubLiminal laser uses yellow wavelength, multispot technology, and a low 5% duty cycle. The 577 nm wavelength allows surgeons to titrate power directly under SubLiminal mode and to reach a barely visible endpoint (Figure 2). The use of the multispot mode to deliver the SubLiminal treatment is important because it ensures a confluent delivery of the laser spots, limiting the risk of undertreatment,<sup>2</sup> which is the most common cause of treatment failure (Figure 3).

- Eliminate iatrogenic damage from laser photocoagulation
- Each laser pulse is divided into repetitive multiple short pulses separated by an off period which allows the tissue to cool between the short pulses

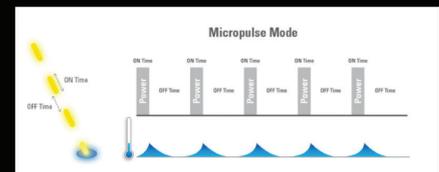


Figure 1. A low duty cycle eliminates iatrogenic damage from laser photocoagulation.

- To obtain the best results with maximum efficacy and safety, the ideal laser should have
  - High energy absorption by the RPE and blood (hemoglobin)
  - Low energy absorption by xanthophyll (pigment present in the macular area)

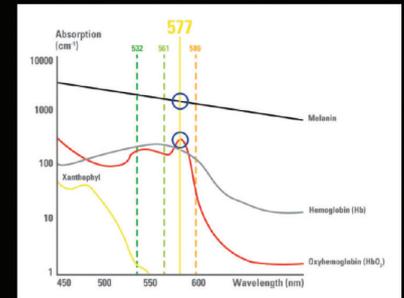


Figure 2. The 577 nm wavelength allows for titration directly under SubLiminal

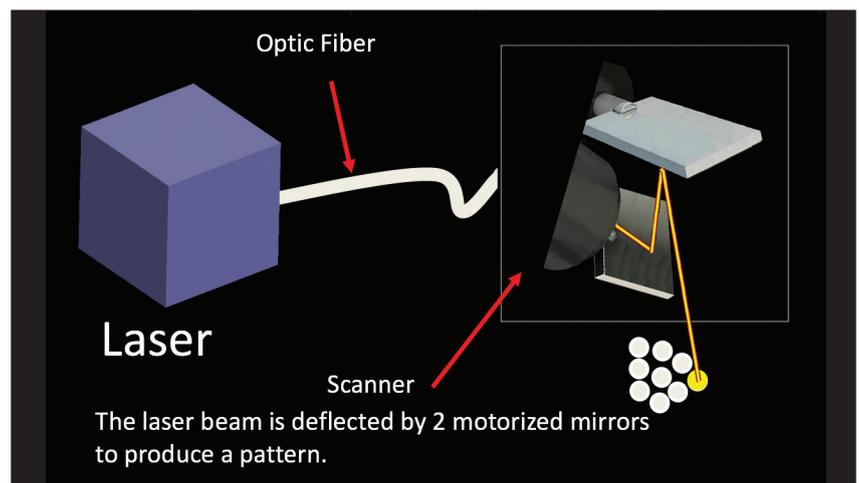


Figure 3. The use of the multispot mode ensures a confluent delivery of the laser spots.

## CASE STUDIES

The first case is a pre-SubLiminal laser patient where the areas of hyperpermeability in the indocyanine green can be seen on optical coherence tomography (Figure 4). Before treatment, BCVA is 20/80. Following SubLiminal laser, BCVA improves to 20/30 (Figure 5).

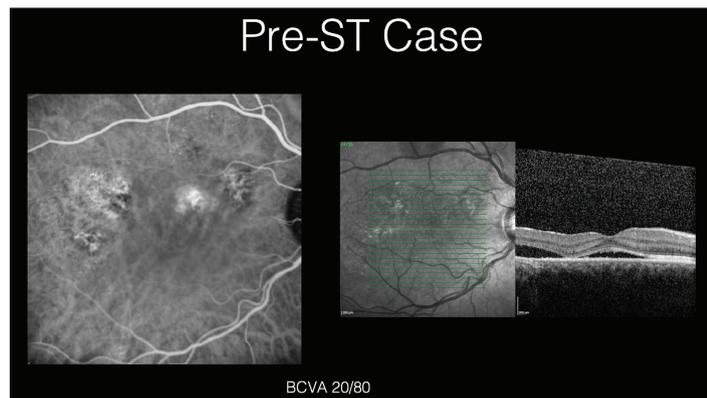


Figure 4.

The next case is a half-dose PDT patient. The patient's serous detachment in the macular area is visible in the fluorescein and indocyanine green (Figure 6). Before treatment, BCVA is 20/200. After treatment with PDT, BCVA improves to 20/70 (Figure 7).

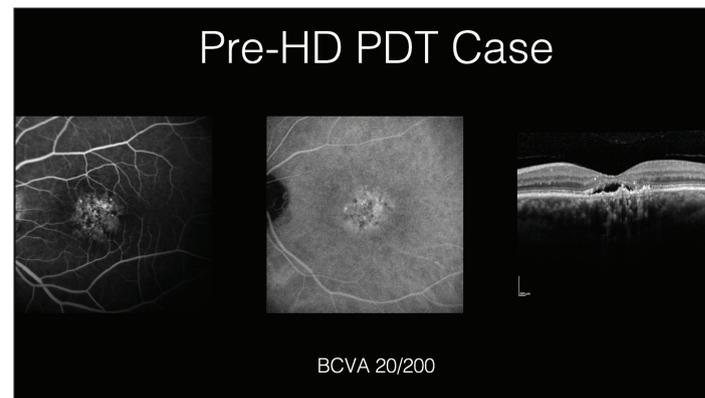


Figure 5.

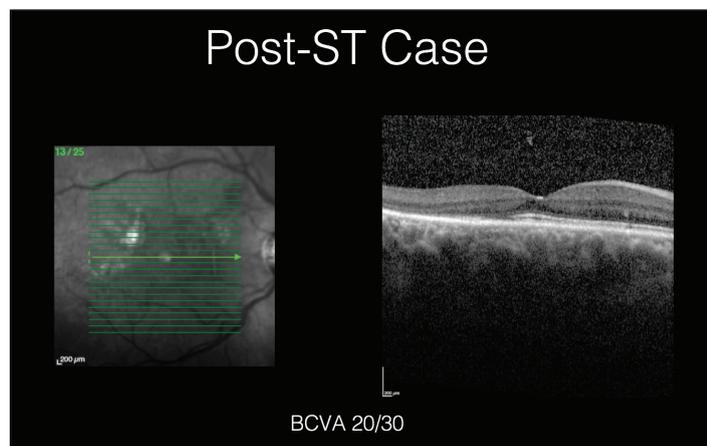


Figure 5.

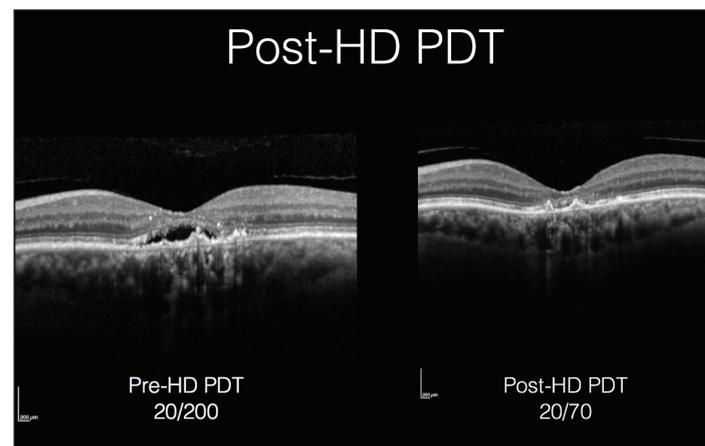


Figure 7.

In Prof. Dr. Sascha Fauser's study, 42 eyes were treated with yellow SubLiminal and 58 eyes were treated with half-dose PDT.<sup>3</sup> The study showed that the yellow SubLiminal laser was more effective in eliciting a response than the half-dose PDT, which was in line with our results.

### CSCR PACORES Study

The purpose of the CSCR PACORES study was to compare the functional and anatomical outcomes of eyes with chronic CSCR treated with yellow SubLiminal laser versus half-dose PDT at 12 months of follow-up (unpublished data). This was a retrospective comparative study of 66 eyes that were treated with yellow

SubLiminal laser, and 67 eyes were treated with half-dose PDT. Chronic CSCR was defined as persistent subretinal fluid lasting for 6 months or longer.

The SubLiminal laser method used a duty cycle of 5%, pulse duration of 200 milliseconds, and—this is important—no spacing between burns. This was a high-density grid pattern with spot

**TABLE 1. BASELINE CHARACTERISTICS**

	ST (n = 66)	PDT (n = 76)	p
Mean Age (years)	42.3 ± 10	47.2 ± 10.8	NS
Mean Duration of Symptoms (months)	10.5 ± 10.5	15.8 ± 14.6	NS
Mean CMT (µm)	403 ± 99	352 ± 184	NS
Mean SFCT	437 ± 76	421 ± 110	NS
Mean BCVA (logMAR)	0.41 ± 0.29 (20/51)	0.50 ± 0.34	NS

**TABLE 2. 12-MONTH RESULTS**

	ST Baseline (n = 53)	ST 12 Months (n = 53)	PDT Baseline (n = 30)	PDT (n = 30)
Mean CMT (µm)	429 ± 73	284 ± 66 (p<0.0001)	470 ± 170	247 ± 84 (p<0.0001)
Mean SFCT	329 ± 94	429 ± 70 (p<0.0937)	297 ± 38	335 ± 70 (p<0.0001)
Mean BCVA (logMAR)	0.29 ± 0.28	0.19 ± 0.25 (p<0.0001)	0.44 ± 0.40	0.47 ± 0.37 (p<0.4820)

**TABLE 3. 12-MONTH RESULTS**

	ST	PDT
≥ 3 line gain from baseline	31/66 (47%)	13/67 (19%)
± 2 lines baseline	33/66 (50%)	49/67 (73%)
≥ 3 line loss	2/66 (3%)	5/67 (7%)

sizes of approximately 160 µm. In terms of power titration, there was a single spot under the SubLiminal mode outside the arcades until a barely visible burn, and then the power was turned down to 50%. Power ranged from 320 mW to 660 mW. In terms of PDT, this was half-dose so it was 3 mg/m<sup>2</sup> verteporfin. After a 10-minute infusion, the laser was activated for 83 seconds, and the spot sizes ranged between 400 and 2,000 µm.

The baseline characteristics of the SubLiminal mode and the PDT group were fairly balanced (Table 1). It is important to note that we are not really comparing the SubLiminal mode group with the PDT group, instead we are comparing the outcomes within the groups. At 12 months in the SubLiminal mode group (n = 53), there was a statistically significant decrease in central

“[In the CSCR PACORES study], the visual results are better with the SubLiminal laser compared to PDT. There are more 3-line gainers in the SubLiminal group compared to the PDT group. There is also a shift toward better visual acuities in the SubLiminal group as compared to the PDT group.”

macular thickness (from 429 ± 73 to 284 ± 66; P < .0001), no change in terms of subfoveal choroidal thickness, and an improvement in BCVA (from 0.29 ± 0.28 to 0.19 ± 0.25; P < .0001). In the PDT group (n = 30), there was an improvement in the central macular thickness (from 470 ± 170 to 247 ± 84; P < .0001) and subfoveal choroidal thickness (from 297 ± 38 to 335 ± 70; P < .0001), but BCVA did not improve (Table 2).

The visual results are better with the SubLiminal laser compared to PDT (Table 3). There are more 3-line gainers in the SubLiminal group compared to the PDT group (47% vs 19%). There is also a shift toward better visual acuities in the SubLiminal group as compared to the PDT group.

In terms of recurrences, the average number of treatments for the SubLiminal group was 1.33, with a range of one to four treatments. In the PDT group, the average number of treatments was 1.19 with a range of one to three treatments. There were no complications in the SubLiminal group at the 12-month follow-up. In the PDT group, one eye developed choroidal neovascularization and was treated with three intravitreal injections of bevacizumab (Avastin; Genentech).

## Conclusion

Both the half-dose PDT and the yellow SubLiminal laser are effective in restoring the macular anatomy in eyes with chronic CSCR. It appears, though, that yellow SubLiminal laser has a more beneficial effect in visual acuity than half-dose PDT. ■

- Cheng CK, Chang CK, Peng CH. Comparison of photodynamic therapy using half-dose of verteporfin or half-fluence of laser light for the treatment of chronic central serous chorioretinopathy. *Retina* 2017;37(2):325-333.
- Lavinsky D, Cardillo JA, Melo LA, et al. Randomized clinical trial evaluating mETDRS versus normal or high-density MicroPulse photocoagulation for diabetic macular edema. *Invest Ophthalmol Vis Sci*. 2011;52(7):4314-4323.
- Scholz P, Altay L, Fauser S. Comparison of subthreshold micropulse laser (577nm) treatment and half-dose photodynamic therapy in patients with chronic central serous chorioretinopathy. *Eye*. 2016;30:1371-1377.

## Lihteh Wu, MD

- in private practice at Macula, Vitreo, and Retina Associates of Costa Rica
- lihteh@gmail.com
- Financial disclosure: speaker for Quantel Medical