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Lasers for Retina

When to use laser therapy, treatment guidelines, and why it matters.



When to Use Thermal or Subthreshold Laser?

BY VICTOR CHONG, MD, MBA

Thermal and subthreshold lasers serve specific purposes to address retinal diseases and conditions. Knowing when to use each laser is dependent on the nature and severity of the condition.

A BREAKDOWN OF KEY USES

Subthreshold lasers. The primary goal of subthreshold laser therapy is to improve retinal pigment epithelium (RPE) function without causing cell death. The focus of the treatment is to induce microenvironmental changes that achieve a therapeutic effect. A subthreshold laser is well suited to address diabetic macular edema (DME), central serous retinopathy (CSR), and microaneurysm closure.

Thermal lasers. The primary goal of thermal laser therapy is to use heat to cause intentional damage to targeted retinal tissues. This treatment, which eliminates RPE cells and often photoreceptors, is well suited to address proliferative diabetic retinopathy (PDR), retinal tears and detachment, retinal holes, and peripheral retinal tumors.

TARGET THE RPE, NOT THE RETINA

Most retinal laser systems use photocoagulation to target treatment at the retina. We now know, however, that the laser's energy is absorbed by RPE cells during treatment for macular disease, altering the microenvironment and subsequently leading to microaneurysm closure. Additionally, a sublethal zone—the area where cells are not dead but undergo changes in response to laser treatment—facilitates the absorption of edema.

The difficulty is finding the optimal energy level to avoid an insufficient effect or excessive tissue damage. Subthreshold lasers address these challenges by delivering energy in pulses, allowing the tissue to cool between pulses, increasing the sublethal zone, and reducing the dead zone (Figure). On the other hand, thermal lasers leave behind a scar that progressively enlarges with time.

SHORT- AND LONG-TERM BENEFITS

Thermal and subthreshold lasers have unique benefits. A study of 266 patients with DME, the DIAMONDS study, found that, while both treatments were equally effective in the short term, eyes treated with Subthreshold Laser Therapy had less visible

scarring,¹ suggesting possible long-term benefits compared to thermal laser therapy. All eyes in the study had a central retinal thickness of less than 400 μm .

Treatment with a thermal laser is the best option for PDR, where the aim is to destroy the ischemic retina. A thermal laser also has benefits for treating retinal tears and peripheral retinal tumors, as well as other specific cases.

CONCLUSION

Subthreshold lasers can enhance RPE function without causing cell death. Its main uses are for the treatment of DME and CSR. Alternatively, thermal multispot lasers are better to target cell and photoreceptor destruction for conditions like PDR and retinal tumors.

1. Lois N, Campbell C, Waugh N, et al. Diabetic macular edema and diode subthreshold micropulse laser: a randomized double-masked noninferiority clinical trial. *Ophthalmology*. 2023;130(1):14-27.

VICTOR CHONG, MD, MBA

- University College London, Institute of Ophthalmology, London
- University of Utah, Salt Lake City
- victor@eretina.org
- Financial disclosure: Consultant (Lumibird Medical)

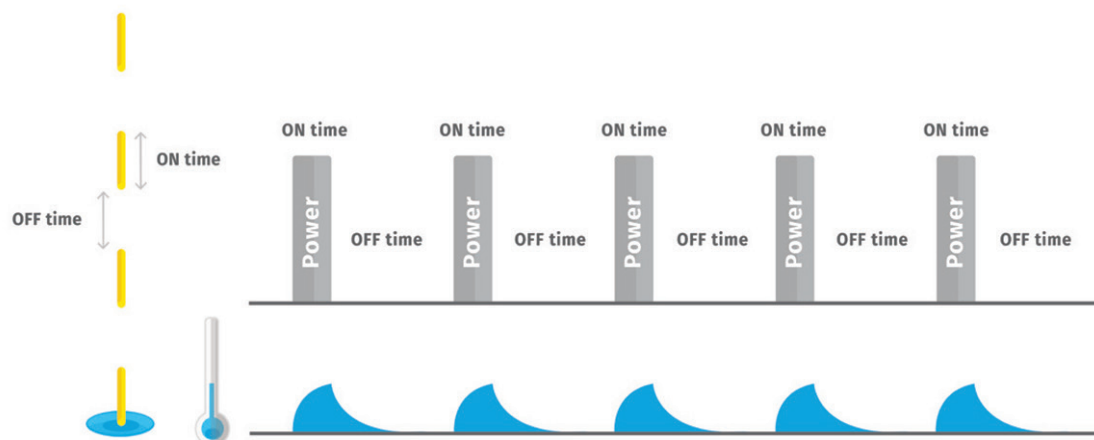


Figure. Subthreshold lasers deliver energy in pulses, allowing tissue to cool between each pulse.



Why You Should Be Using a Subthreshold Laser

BY KENNETH FONG, MA, MB
BCHIR, FRCOPHTH, FRANZCO

Intravitreal anti-VEGF therapy is the first-line treatment for DME. A laser treatment within the clinical setting, however, can be effective in many situations. In the DRCR.net Protocol T, between 40% and 60% of patients who received nine or 10 anti-VEGF injections in the first year of the study had a history of laser therapy.¹

Conventional laser systems use a small spot size, which causes retinal atrophy and thinning in the areas of the laser application. Subthreshold lasers are now used routinely for many retinal diseases and use a train of microsecond pulses combined with a large spot size. They have proven efficacy without showing any visible signs of damage to the eye of the examiner.²

SUBTHRESHOLD LASER TYPES

There are three types of modern subthreshold lasers.

SubLiminal. This type of laser is used for Subthreshold Laser Therapy treatment. It is based on the emission of short repetitive pulses that last for microseconds, allowing significant cooling of the tissue between the pulses.

Endpoint management. This type of laser provides continuous energy delivery with decreased power levels and duration in attempt to achieve no visible scarring.

Nanosecond laser. This type of laser has similar specifications to those used for selective laser trabeculoplasty.

Modern subthreshold lasers can be titrated and customized by varying power settings, shortening the pulse duration, and using pulses to achieve a targeted endpoint. For DME and CSR, I use SubLiminal Laser Therapy with a 5% duty cycle, 160- μ m spot size, and a 200-millisecond duration in a confluent pattern. For the former, an OCT thickness map is used to visualize the macular thickness. For the latter, a fluorescein angiogram is used to identify the areas of leakage.

LASER GUIDELINES

The Subthreshold Ophthalmic Laser Society (SOLS) has published laser guidelines for retinal diseases. The society recommends the use of a 5% duty cycle, 200-millisecond pulse duration, between a 150- to 200- μ m spot size, and no spaces between the spots.

The laser energy must be titrated prior to treatment. Once the threshold power level is identified, 50% of it is used for the treatment of the thickened areas for DME or the hotspots for CSR (Figure).

REDUCE PATIENT APPOINTMENTS

Anti-VEGF therapy is demanding. Many patients with DME can't keep up with their injections. I find that supplementing anti-VEGF therapy with subthreshold laser treatments can reduce their visits to the clinic.

I usually perform one anti-VEGF treatment to reduce the edema and supplement it with a subthreshold laser treatment. A lot of patients don't require further injections after about 3 to 6 months of the combined treatment strategy.

CONCLUSION

SubLiminal Laser Therapy does not show any visible signs of damage to the eye.² It can be used as a standalone treatment as well as an adjunct therapy for patients with DME.

1. Wells J, Glassman A, Ayala A, The Diabetic Retinopathy Clinical Research Network. Aflibercept, bevacizumab or ranibizumab for diabetic macular edema. *N Engl J Med*. 2015;26:372:13:1193-203.

2. Chong V. How new generation lasers are different from each other? *Ophthalmotherapy*. December 2018. Accessed November 16, 2023. <https://www.journalsmededu.pl/index.php/ophtotherapy/article/view/542>

KENNETH FONG, MA, MB BCHIR, FRCOPHTH, FRANZCO

■ Consultant Ophthalmologist, Vitreoretinal Surgeon and Managing Director, Oasis Eye Specialists, Kuala Lumpur, Malaysia

■ ken.fong@oasiseye.my

■ Financial disclosure: Honoraria (AbbVie/Allergan, Bayer, Novartis, Roche); Consultant (Lumibird Medical, Iveric Bio, Rxelient)

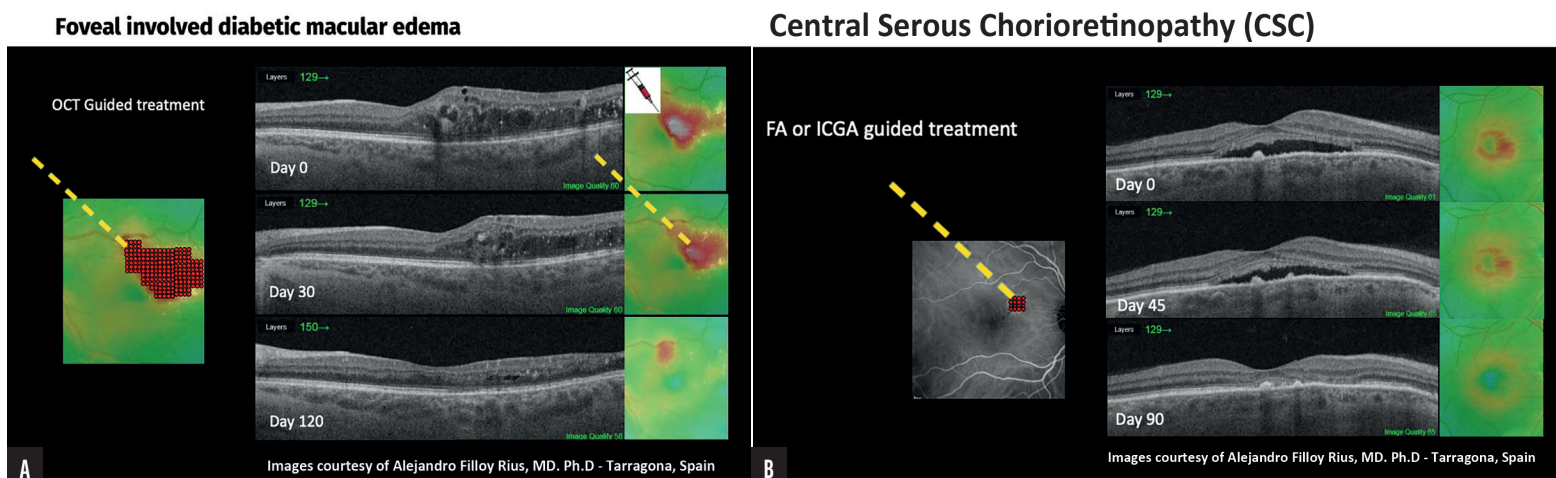


Figure. OCT-guided treatment for DME (A) and angiography-guided treatment for CSR (B).

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Subthreshold Laser Therapy in the Real World

BY ALEJANDRO FILLOY RIUS,
MD, PHD, FEBO

In my clinic, SubLiminal Laser Therapy has emerged as a leading treatment for macular diseases. I typically use the treatment procedure recommended by the SOLS society.

Power titration is required prior to treatment to prevent variability in treatment response between patients—particularly those with pigmented fundus, where lower power may be needed.

SubLiminal Laser Therapy is a versatile procedure. Both center-involving and non-center-involving DME can be treated with this laser therapy, with or without a combination of IV drugs. OCT is used to guide treatment. A retreatment should not be considered until about 12 weeks because

it takes this kind of time for the treatment to show its effect.

I also use SubLiminal Laser Therapy for chronic and acute (at least 1 month) CSR. The demonstrated effectiveness, simplicity, and safety of the procedure position it as a viable first-line treatment. Treatment should be applied to a large area, concentrating around the leakage point. Follow-up should be scheduled after 6 weeks to assess for response and a potential retreatment.

Historically, photodynamic therapy (PDT) lasers have been used to treat chronic CSR. Until recently, the PLACE trial was the only prospective, randomized, controlled trial comparing subthreshold laser with half-dose PDT in patients with chronic CSR.

In this trial, half-dose PDT was reported to be superior to subthreshold laser in terms of the rate of complete resolution of subretinal fluid and retinal sensitivity improvement

on microperimetry. The methodology of subthreshold laser delivery in this study and its data analysis, however, has been strongly contested by experienced laser practitioners.

A recent prospective, double-masked, randomized, controlled clinical trial compared anatomical and functional outcomes of half-dose PDT and yellow 577 nm subthreshold subliminal laser in treating patients with CSR.¹ It demonstrated that subthreshold laser therapy is slower but just as good as PDT.

SAFETY CHECKS

Transfoveal treatments are not recommended for beginner surgeons, and they are also not necessary. Treating a large enough area allows you to spare the fovea. During treatment, check for any visible changes in the retinal tissue. If present, the power must be lowered.

I also check the fluence to make sure I'm within safe parameters just before initiating treatment. A good rule of thumb is that under 12 J/cm² you will never cause retinal damage. Between 12 and 20 J/cm² will be safe in the vast majority of cases (Figure), and over 20 J/cm² you should start being careful depending on the patient's pigmentation or in thin retinas due to chronic conditions. Strong variability may appear in the energy-absorption by the RPE between patients, hence the importance of titration as stated in the beginning.

Lastly, I recommend checking the guidelines established by the SOLS to ensure a reproducible and sound technique. ■

1. Brelen M.E., Ho M., Li S., Ng D.S.C., Yip Y.W.Y., Lee W.S., Chen L.J., Young A.L., Tham C.C. & Pang C.P., Comparing half-dose photodynamic therapy with subthreshold micropulse laser for the treatment of central serous chorioretinopathy. *Ophthalmology Retina* (2023), doi: <https://doi.org/10.1016/j.oret.2023.10.024>.

2. Add a PLACE reference



Figure. Check the fluence to make sure treatment parameters are safe.

ALEJANDRO FILLOY RIUS, MD, PHD, FEBO

- Clínica Oftalmológica Tarragona, Spain
- Hospital Universitari Joan XXIII, Tarragona, Spain
- alejandروفilloy@gmail.com
- Financial disclosure: Lecture fees (Lumibird Medical)