Formation of the Subthreshold Ophthalmic Laser Society

Establishing best practices in subthreshold laser treatment.

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Laser photocoagulation has been used in ophthalmology for many years. During photocoagulation, a continuous wave of energy is delivered to the target tissue throughout the entire duration of the laser pulse. In the past, visible burns were believed to be necessary for a successful treatment, and the traditional endpoint was therefore the achievement of a visible (threshold) grayish burn. This grayish-white burn translates histopathologically to tissue necrosis of the targeted and adjacent tissues. The biggest downside to laser photocoagulation is the iatrogenic tissue damage caused by the treatment.[1,2]

More recently, however, uses for ophthalmic lasers have been discovered that don't involve killing the cells but instead involve activating the cells through heat to achieve a specific biological effect.[3] This discovery has changed the way that we think about ophthalmological laser therapy and has led to significant developments and improvements in patient care. Most of the revolutions in laser treatment began in retinal surgery, but more recently we have seen innovations being developed in glaucoma as well.

Over the past several months, and in conjunction with colleagues, a new society has been formed to help establish guidelines and best practices in subthreshold laser therapy and to help change the misperceptions about how this laser technology works. This new organization, the Subthreshold Ophthalmic Laser Society (SOLS), aims to promote a better understanding of subthreshold laser technology, to improve awareness of best practices, to dispel a lot of the misunderstanding surrounding the concept of laser treatment, and to uncover more nuances in this mode of patient care.

We recently participated in the CAKE & PIE Expo in June in order to create a central depository of educational material on the use of subthreshold laser treatment for macular diseases, including central serous chorioretinopathy (CSR), diabetic macular edema (DME), and macular edema secondary to branch retinal vein occlusion. It may also be helpful in glaucoma. This article provides an overview on subthreshold lasers and summarizes some of the presentations made during the expo.

NEW LASERS IN RETINA

Conventional laser photocoagulation, also known as *continuous wave photocoagulation*, has been used for many years to reduce the ischemic effects associated with retinal disease such as proliferative diabetic retinopathy. For macular laser, however, the main goal of the treatment was to destroy the lesions such as microaneurysms or leaking points of CSR. Researchers recently discovered that one does not need to destroy the lesions. Rather, by activating the retinal pigment epithelium (RPE), these leaking lesions would be closed. Laser photocoagulation incurs side effects that include neuronal damage, macular neovascularization, and subretinal fibrosis for macular laser and visual field loss for panretinal laser.

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The development of subthreshold micropulse laser technology is an exciting alternative to conventional laser photocoagulation in macular diseases. Also known as *SubLiminal laser*, these laser treatments cause no clinical or histologic evidence of photoreceptor damage at the time of application. The biggest advantage of subthreshold laser treatment is that it can be used to eliminate the

Subthreshold Laser Attributes

There are many ophthalmic lasers in the market that allow subthreshold treatments. Most importantly, the key characteristics of a subthreshold laser include that it uses the yellow wavelength (577 nm), includes multispot technology, and uses a low duty cycle (5%).

Yellow wavelength. To obtain the best results with the maximum efficacy and safety, the ideal laser should have a uniform thermal effect, good penetration through opacities, and low energy absorption by xanthophyll, which is the pigment present in the macular area. The main chromophores that absorb laser energy are melanin and hemoglobin. A laser that uses the yellow wavelength is advantageous because it has a high absorption in melanin, oxy-hemoglobin, and hemoglobin, and it avoids the absorption of xanthophyll in the macular area.[1] It is also superior to an infrared (880 nm) laser, as the surgeon can titrate the power for individual patients. Undertreatment is a common cause of poor efficacy, as shown in the PLACE study.[2]

Multispot technology. The best results are obtained when the subthreshold treatment incorporates a confluent density of laser spots. A multispot laser platform is mandatory because it allows confluent laser therapy, which reduces the risk of undertreatment. Conversely, monospot application is difficult because the burns are invisible, making it hard to decipher where each one is placed. Multispot technology ensures that the treatment is delivered as intended.

Duty cycle. A low duty cycle reduces the exposure time and allows the tissue to cool off between pulses.[3]

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unwanted iatrogenic damage that occurs with conventional macular photocoagulation.[4] SubLiminal laser can reduce the exposure time by breaking down the pulse duration into several micropulses. By manipulating the duty cycle, the laser energy is therefore only applied for a fraction of the duration of the pulse, allowing the tissue to cool off between pulses. This results in low thermal diffusion to the adjacent structures. Because of these characteristics, SubLiminal laser is particularly suited for macular diseases.

TREATMENT GUIDELINES

Subthreshold lasers produce no intended thermal injury.[5] A dense treatment that uses large spot sizes (160 µm) and increases the treatment area is therefore possible. Guidelines for the proper laser settings include the following:

- Spot size: 160 µm;
- Duty cycle: 5%; and
- Exposure time: 0.2 seconds.

Before each procedure, the power should be titrated. First, the thermal threshold is determined by increasing the power level until a barely visible endpoint is reached. Then, that power is decreased by 50%. Some surgeons prefer to have a slightly more visible endpoint but then reduce the power to 30%. The multispot delivery mode is used to implement the treatment. During treatment, no visible reaction must be observed. There is no need to change the power for different degrees of edema. It is also important to audit your results in the learning phase to see whether there are any visible reactions in the retina a few months after treatment. It is common to have too much power in the beginning. Lower power and more spots may be better than more power and less spots.

In our experience, subthreshold laser treatment is best suited for CSR, non-central DME, and as an adjunct for center involved DME.

CONCLUSION

SOLS is a new society that was formed to help establish guidelines and best practices in subthreshold laser therapy in at least three languages (English, Spanish, and Mandarin Chinese). Through our work and messaging, we hope to change the misperceptions about subthreshold laser technology and to promote a better understanding of this laser technology. With an improved awareness of best practices, we can hopefully uncover more nuances in this mode of patient care. ■

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