OCULAR SURGERY NEWS

# Subthreshold laser therapy yields good outcomes

The tissue-sparing treatment avoids collateral thermal damage to surrounding structures and has many ophthalmic applications.

Ocular Surgery News U.S. Edition, November 10, 2012 *David D. Gossage, DO*

Laser photocoagulation is the current gold standard in the treatment of diabetic macular edema. Both the Diabetic Retinopathy Study and the Early Treatment of Diabetic Retinopathy Study show that laser photocoagulation reduces the risk of vision loss in cases of diabetic retinopathy. While this therapy has been refined and made safer since its inception and its efficacy has been validated by many studies, the issue of collateral thermal damage to surrounding structures has always remained.

Threshold, or visible, grayish endpoints associated with traditional continuous-wave (CW) focal and grid argon laser treatments represent thermal damage to the photoreceptors in the back of the eye. Eventually, the death of photoreceptors in the macular region can result in a loss of vision. Also, the loss of capillaries from diabetes or the occlusion of these vessels from the laser treatment itself can cause loss of vision. Furthermore, scars induced by traditional CW laser spots have a tendency to expand over time, so treatments close to the center of the macula may enlarge and become more atrophic, and those atrophic spots may extend into areas of the fovea and macula, leading to additional vision loss. Thus, while traditional CW laser therapy improves some of the diabetic macular edema (DME), there are downsides as well.

Subthreshold, or non-visible, MicroPulse laser therapy (MPLT) has been found to be beneficial in a number of diseases. By using sublethal doses of MPLT to more closely confine laser-induced thermal elevations to directly targeted tissues, the visible laser burns, as well as many of the unwanted side effects associated with traditional CW laser therapy, can be avoided. The short bursts and relatively low amounts of laser energy used in MPLT eliminate much of the thermal spread and lethal injury that occur with CW laser therapy. MPLT is used to stimulate, or “tickle,” cells, which then express a number of beneficial factors during their subsequent healing response.

I have begun using the IQ 532 laser with the MicroPulse module (Iridex) for a variety of pathologies including DME, proliferative diabetic retinopathy, retinal tears and glaucoma. I am finding that conducting tissue-sparing laser therapies with the use of the Micro-Pulse module is producing very impressive outcomes.

**Case study 1**

A 75-year-old woman was diagnosed with diabetes in 2002 and as a result manifested DME. I treated her DME in December 2004, February 2008, July 2008 and February 2009 with traditional CW argon laser photocoagulation. In February 2009, I also gave her an injection of Kenalog (triamcinolone acetonide, Bristol-Myers Squibb) for attenuating the VEGF-mediated retinal capillary permeability that is presumed to contribute to DME. In October 2010, she received another CW argon laser photocoagulation treatment, and then in December 2011, I performed her first MPLT session. Her baseline retinal thickness was 434 µm, and her visual acuity was 20/50. To determine the power used for MPLT, I first performed a CW test burn over the

edematous area using a 100-µm spot size (on the slit lamp adapter), a Mainster focal grid contact lens (1.05× laser magnification), 100 mW of power and a 100-ms duration. I increased the power by 50-mW increments (moving to adjacent locations) until I saw a visible tissue reaction. I then switched the laser to its MicroPulse mode using a 5% duty cycle, decreased the power by 70% and doubled the duration to 200 ms. In this case, I delivered 154 applications of a 100-µm spot at 70 mW of power and a 200-ms duration using a 5% duty cycle. I used a paintbrush technique, consistently moving back and forth over the area of edema that I wanted to treat. Even with this low amount of laser energy, her retinal central thickness reduced from 434 µm to 317 µm. She responded so well that at her last follow-up at 3 months, she did not develop any recurrence of her macular edema that needed to be re-treated.

**Case study 2**

A 28-year-old man was diagnosed with type 1 diabetes at the age of 2 years. I performed argon focal/grid laser to treat his DME in February 2006 and July 2008. In December 2011, I performed MPLT using a 100-µm spot size, 80 mW of power, a 200-ms duration and a 5% duty cycle and delivered 111 shots. During the test burn in CW mode, a visible tissue reaction was achieved at 100 µm, 100 mW and 100 ms.

In March 2012, 3 months after treatment, he had no resolution of the DME of his central macula and only a little resolution of the superior edema, with just a 9 µm reduction in macular thickness. At this point, I learned that in MicroPulse mode, it is possible to treat with a higher power and still not have thermal spread. I re-treated the patient with 216 shots of 100-µm spot at 200 mW of power with a 200-ms duration and a 5% duty cycle. There were no visible endpoints, indicating that tissue was not being destroyed and no harm was being done to the retina. His baseline central retinal thickness was 323 µm, which decreased to 297 µm 1 month after treatment. The improvement was very dramatic visually on the optical coherence tomography scans and is typically not seen with CW argon laser photocoagulation at only 4 weeks after treatment.

I now treat my patients more heavily (high-density applications), using the same paintbrush technique back and forth but followed by an up-and-down motion, so I am essentially creating a grid over the area I want to treat. Thus, not only am I using a much higher power, I am also applying the laser twice. With this treatment technique, I am seeing excellent results in patients with type 1 and type 2 diabetes, still without seeing any thermal damage. There is no evidence of thermal damage on fluorescein angiography in post-treatment eyes.

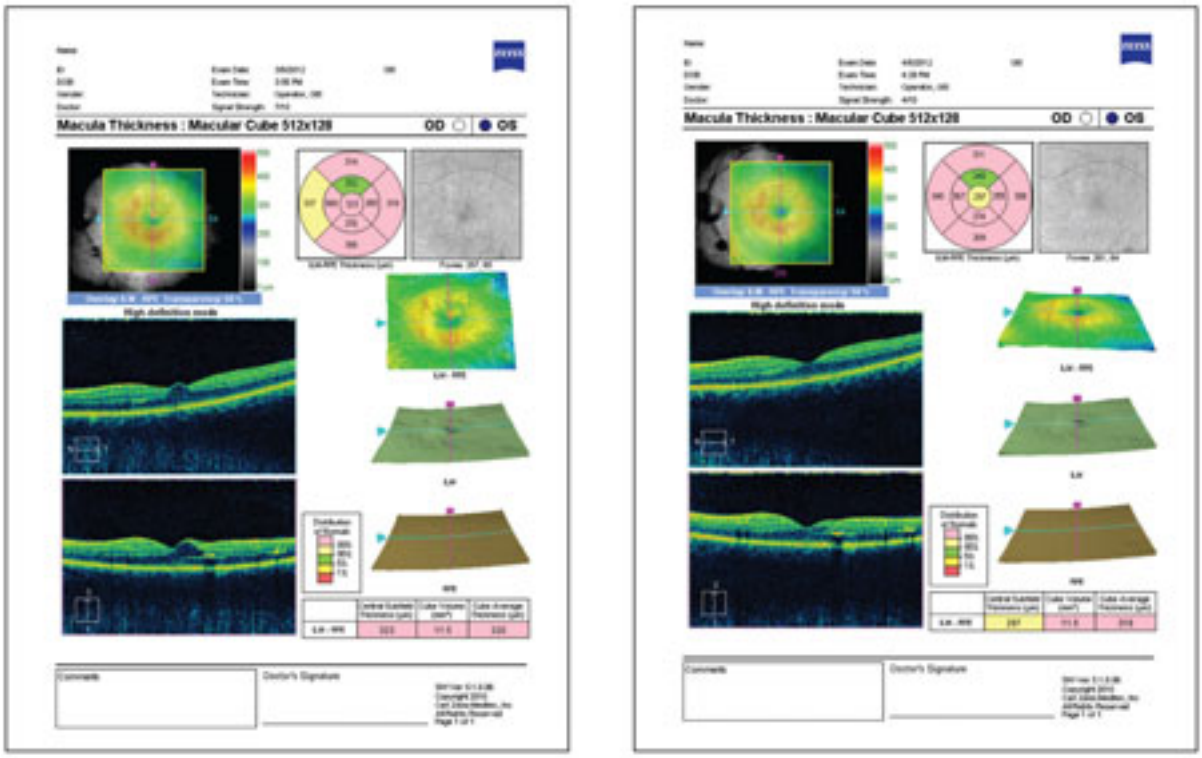


Image on left displays the macular thickness in a 28-year-old patient with type 1 diabetes, pre-treatment. Image on right displays the macular thickness in the same patient with type 1 diabetes, post-treatment.

**Subthreshold lasers and glaucoma**

I have also been using the IQ 532 laser with MicroPulse to perform subthreshold MicroPulse laser trabeculoplasty (MLT) for lowering IOP in my glaucoma patients to great success. Initially, I was using a 300-µm spot diameter at 300 mW of power for 300 ms at a 15% duty cycle, and I was seeing an approximate 18% reduction in pressure. Now, I am using a 300-µm spot diameter at 600 to 700 mW of power for 300 ms, and I am seeing an even greater reduction in IOP.

One of the benefits of MLT over traditional argon laser trabeculoplasty is that it does not cause any thermal damage to the trabecular meshwork, making the procedure reproducible if necessary at a later date. With other forms of trabeculoplasty, the thermal damage caused in the angle structure would prevent re-treatment. In addition, MLT seems to not cause the pressure spikes that sometimes happen after selective laser trabeculoplasty or ALT.

I find that MLT is an excellent alternative to a glaucoma drop, with similar efficacy. Once a patient begins to use an ocular hypotensive medication, after 2 years they will likely need to start on another medication or look at other treatment options. With MLT, after the same time period, a patient may also need to look at an additional MLT treatment or other options. However, there is no difference in visual field loss, progressive blindness or progressive nerve change between the treatments as long as the target IOP is maintained.

Studies have shown that patients are largely noncompliant with topical glaucoma medications, and as people age, dry eye becomes more of an issue and medications with preservatives may exacerbate this condition. Multiple medications lead to more irregularities of the corneal surface, with dry eye and more blurred vision down the road. Alternative treatments such as MLT are gaining favor with the glaucoma community because they avoid the lack of compliance and other issues associated with glaucoma drops.

**Summary**

The ability to user laser therapies without collateral thermal damage is a very exciting development that has a variety of ophthalmic applications. With MicroPulse, I am now using higher powers than I initially used and seeing greater results with no thermal damage with both my glaucoma and DME treatments. There is a learning curve with subthreshold laser due to the lack of visible endpoints, but the surgeon simply needs to cover the desired treatment area with laser applications and know that the results will be seen after treatment.