

Know your tools, help your patients

June 1, 2017

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The only “reason for time,” said Einstein, is so everything won’t occur at once.

The point? The four authors of the following cases took advantage of time to learn about the tools in their possession, whether for dry eye disease or diabetic macular edema. The gain from that time spent? A little more knowledge apparently went a long way.

SWAPPING A NEEDLE FOR A LASER

In Colombia, patients who need intravitreal injections face many hurdles to get them. This physician circumvented those problems.

Munir Escaf, MD

I became interested in laser options for the treatment of patients with central, branch, and retinal vein occlusion (RVO), diabetic macular edema (DME), and chronic or acute central serous retinopathy (CSR) because treating with injections is often problematic in my country. In Colombia, there are many barriers that patients face to obtain drugs such as bevacizumab (Avastin, Genentech).¹ I often had to delay treatment of conditions such as CSR until it was determined that it would not resolve spontaneously; obviously this was not a realistic or ideal situation. Laser treatment, on the other hand, could be implemented immediately, enabling me to treat patients before permanent damage occurred. So in 2012, while visiting in the United States, I bought a MicroPulse laser IQ 577 laser system (Iridex Corporation).

Perhaps the biggest hurdle I encountered when first using the laser was overcoming the fear of delivering it transfoveally. A company representative trained me and talked me through my first treatments. I slowly became more comfortable, though I continued to check results with angiogram, OCT and visual fields after every treatment. My anxiety that adverse events would occur was diminished after a month or so of treating numerous patients. Consequently, I increased my use of the laser.

TREATMENT ALGORITHM

While the laser treatments did garner favorable results, I noticed that in some circumstances, results were not quite as good as I expected. Therefore, in 2015, I began to evaluate my cases and noticed that the outcome was not as good if the central macular thickness (CMT) was greater than 300 μm . I carefully reviewed all my patients’ charts and evaluated the results achieved after the first, second or third round of therapy. I then further determined if I used the laser before or after anti-VEGF. Based on this information, I developed this algorithm:

For a CMT of less than 300 μm , I begin with the laser and follow up with an OCT five weeks later. If I see no improvement, I will then treat with anti-VEGF. If initial CMT is between 300 μm and 400 μm , I begin with anti-VEGF treatments and follow up after three to four weeks. Once the CMT has fallen below 320 μm , I then treat with the laser. If the initial CMT is greater than 400 μm , I administer a loading dose of anti-VEGF and steroids and follow up after four weeks. I continue with anti-VEGF treatments until the CMT is 320 μm or less, at which point I will treat with the laser.

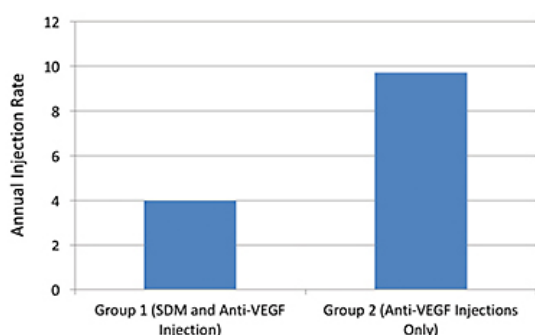
Results

- Group 1 (MicroPulse laser +Lucentis 0.3 mg injections)
 - Average age: 66 yrs
 - Duration of follow-up: 9-30 mo (average 13.7 mo, median 10 months)
 - HgbA1C 7.3
- Group 2 (Lucentis 0.3 mg injections only)
 - Average age: 64 yrs
 - Duration of follow-up: 10-32 mo (average 17.1 mo, median 11 months)
 - HgbA1C 7.8

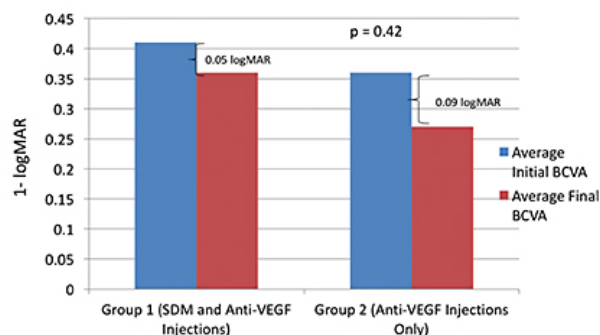
MicroPulse Laser Settings: IQ 577 IRIDEX

Mode	MicroPulse
Duty Cycle	5%
Spot Size	200 μ m
Power	400 mw
Duration	200 ms
Pattern	Confluent including foveal center, dense

Results: Annual Injection Rate



Results: Vision Outcomes



In a pilot study presented at Hawaiian Eye in 2016, Lawrence Morse, MD, PhD, discussed his work involving a retrospective chart review of 14 patients, half of whom had received subfoveal treatment for DME between January 2011 and November 2014. Those seven also received Lucentis (ranibizumab, Genentech); the others ranibizumab only. The results are shown in the charts above.

With CSR patients, I normally deliver laser in the leakage area identified in the angiogram. Although I begin treatment with a threshold test to determine the correct power level, the laser's treatment power is typically 400 mW. I use a 200-millisecond duration, a 5% duty cycle and a 200- μ m spot size on the retina to apply a 7x7 grid over the entire macular area with no spaces between spots.

I usually do laser at the points that are leaking and the compromised area where I find subretinal fluid. If I want to stimulate the RPE to accelerate fluid drainage, I believe that applying laser on the area affected is a good choice.

I strongly recommend that doctors either create an algorithm based on their own results, or if necessary, adapt mine according to their needs. A review of patient results will illustrate how treatments are working and aid in algorithm development.

ADDING A LASER PROBE

The A&I XR extended-reach probe allows for much greater control and range of motion for treating my patient population. The northern part of Colombia experienced a significant migration from Middle Eastern countries around World War I. Consequently, my patient population is largely comprised of people of Arabic descent who possess some large facial features — noses and frontal bones — and deep-set, small eyes. Typical features of the indigenous northern Colombian Indians also include small eyes and prominent cheekbones. These characteristics make endolaser more challenging. For instance, if I use my right hand to treat the left eye, the patient's nose interferes.

Once I began using the A&I XR laser probe, the change was significantly interesting. The probe allowed me to use one hand to cover 90% of the retina when treating 360 degrees, regardless of extenuating circumstances. I typically do an air/fluid exchange and then perform laser treatment under air as it allows for better visualization. I can generally reach the last 10% of the eye using the probe with my left hand.

With this probe it is no longer necessary to push into the eye to reach all treatment areas. The probe is very long and flexible, which provides a significantly extended range.

There was a slight learning curve with the probe. The first time I used it, I extended the angle between my trocars as I believed I needed a bigger arc with the length of the probe. I then realized that the extendable probe is similar to a "regular" probe except that it provides a better reach, allowing me to treat every part of the retina.

REFERENCE

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FEMTOSECOND LASER-ENABLED KERATOPLASTY

Patients with full-thickness or deep anterior lamellar keratoplasty benefit from femto.

Marjan Farid, MD

In recent years, the need for penetrating keratoplasty (PK) has declined, as Fuch's dystrophy and other conditions that cause corneal edema can be effectively managed with endothelial keratoplasties such as DMEK and DSAEK. Corneal crosslinking will further reduce PK rates in the future, but we still see many patients who are candidates for full-thickness keratoplasty or deep anterior lamellar keratoplasty (DALK), depending on pathology severity. These patients include those with severe keratoconus, long-standing corneal edema and corneal scars from herpes keratitis infection or other etiologies.

At the Gavin Herbert Eye Institute, we are employing femtosecond laser techniques, dramatically changing the outlook for PK and DALK patients. We now have a large cohort of >600 femtosecond laser-assisted keratoplasty cases, some with up to 10 years of follow-up. We began performing these cases with the Intralase FS30 and FS60 lasers and now use the iFS 150 kHz laser (Johnson & Johnson Vision). These lasers can create flaps for LASIK, tunnels in intracorneal ring segments and customized trephination patterns for keratoplasty donor and host tissue.

BETTER RESULTS

We have demonstrated that femtosecond laser enabled keratoplasty (FLEK) results in more rapid visual recovery and decreased amounts of astigmatism compared with conventional blade trephination PK.¹

This is largely because the femtosecond laser allows us to perform customized trephination patterns that are too complex to be performed manually. The "zig-zag" pattern (**Figures 1A-C, page 30**) developed by Roger Steinert, MD seems to be the most biomechanically stable and easiest to suture of the available patterns. Additionally, the laser can be used to create tiny alignment divots that allow the surgeon to easily match up the donor and host tissue.

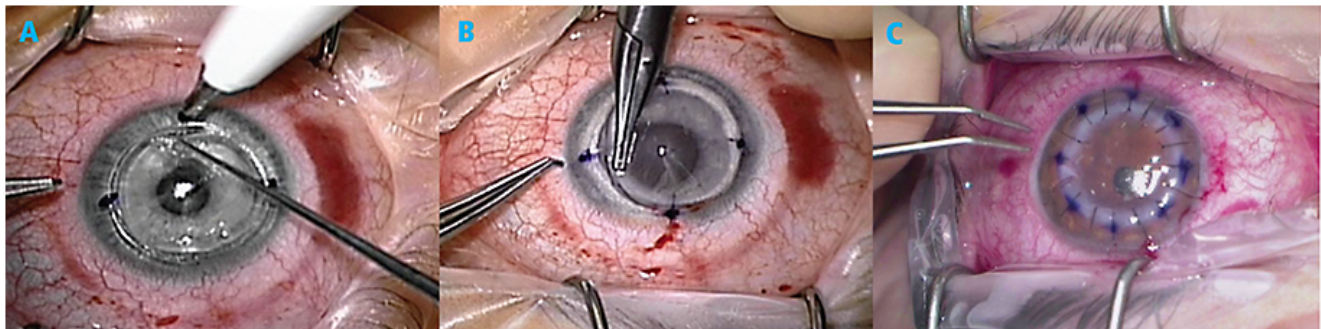


Figure 1A. The radial alignment marks that the laser makes are premarked to allow exact tissue alignment during surgery.

Figure 1B. The anterior, lamellar and posterior side cuts are easily visualized during surgery and guide needle and suture placement.

Figure 1C. Standard suturing technique is employed.

The angled anterior edge of the zig-zag creates close apposition and a smooth transition between the donor and host tissues, avoiding the torsional and vertical misalignment that created irregularities in conventional PK. With laser PK and DALK we are able to remove sutures earlier and achieve faster visual recovery, which is critical for young keratoconus patients. Of the PK patients in our published study with normal macular and optic nerve function, nearly twice as many of those in the laser/zig-zag group vs. the conventional group (81% vs. 45%) achieved BSCVA of 20/40 or better within three months.¹ Femtosecond DALK visual acuity outcomes have been similarly good.² In the larger cohort of >600 eyes (both femto PK and DALK), the average corrected distance visual acuity (CDVA) was 20/25 by postoperative month six.

In our published comparison to conventional PK, the laser/zig-zag group had average topographic astigmatism of just 3.00 D, compared to 4.46 D in the conventional group.¹ Most importantly, the astigmatism is much less likely to be irregular, which means that it can be corrected with glasses rather than rigid contact lenses; we may therefore have the opportunity to perform a subsequent laser vision correction or toric IOL procedure to further improve vision.

TAKE ADVANTAGE OF YOUR TECHNOLOGY

Many corneal surgeons are still performing conventional PK. Some may have been deterred from FLEK by the presumed limitation of not having access to an OR-based femtosecond laser. In fact, we have shown that the host tissue can be cut at a remote laser and the patient safely transported by wheelchair (or even a vehicle) to complete the procedure in the OR. We initially performed more than 50 cases in this manner and still occasionally do remote laser trephination, although we now have an iFS laser in the OR. I would encourage anyone who is performing manual PKs to move to FLEK because the outcomes are so much better for the patient.

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2. Farid M, Steinert RF. Deep anterior lamellar keratoplasty performed with the femtosecond laser zigzag incision for the treatment of stromal corneal pathology and ectatic disease. *J Cataract Refract Surg*. 2009;35(5):809-813.

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Disclosure: Dr. Farid is a consultant to Johnson & Johnson Vision.

LOOKING BEYOND NORMAL

Reconciling dry eye disease and overtearing with a normal tear osmolarity.

Elizabeth Yeu, MD

This was not the most straightforward case of dry eye I had treated.

The 57-year-old woman, a soft contact lens wearer for many years, had come to our practice with complaints of overtearing in both eyes, and also burning and mild itching. Her other pertinent medical history is significant for ulcerative colitis and lichen planus, which she said had been in remission for some time, and mild rosacea.

As for medications not related to dry eye, she was taking minocycline, valacyclovir, levothyroxine sodium and simvastatin. And for dry eye, she had been treated with erythromycin ointment; TobraDex (tobramycin and dexamethasone, Alcon); Lastacraft, (alcaftadine ophthalmic solution, Allergan); Restasis (cyclosporine ophthalmic emulsion, Allergan); and Lotemax (loteprednol etabonate ophthalmic suspension, Bausch + Lomb). Some helped, others didn't, and whatever relief she did receive was temporary.

I looked at her meibomian gland function. There was mild truncation and congestion, but overall, there was good meibomian gland architecture. I discerned mild meibomian gland damage. We also performed other tests (**Figure 1, page 31**).

My diagnosis: a complex, mixed-mechanism dry eye disease with multiple factors. These were:

- Autoimmune history: lichen planus, ulcerative colitis
- SCL wearer
- Rosacea
- Postmenopausal female
- Conjunctivochalasis
- Mild to moderate MGD

The interesting point in this case is the role of tear osmolarity. The patient's score was 296 and 302, both within the normal range. But, overtearing could be compensatory and/or an outflow issue. Also, meibomian gland dysfunction or conjunctivochalasis could be the leading cause or causes of this patient's disease.

TREATMENT

I started the patient with a lid hygiene program of AzaSite (Akorn) in both eyes at bedtime to treat the mild MGD. She was to continue the minocycline and start HydroEye (Science Based Health) and scheduled a six-week follow-up appointment. In follow-up, while the tearing persisted, the burning, redness and itching had improved by 50%. The osmolarity readings were 296 and 295.

A probe and irrigation of the punctae in all eyelids showed no nasolacrimal obstruction or stenosis. An allergy panel was negative. I modified the treatment plan to include a conjunctival chalasis repair with cautery and inferior punctoplasty of both eyelids.

One month after the conjunctival chalasis repair and punctoplasty, the patient was very satisfied. She said she only had occasional tearing and overall, her symptoms were low and her SPEED questionnaire score was 5 — down from 15. Her longterm treatment regimen was to continue HydroEye and use Azasite biweekly.

This clinical scenario is not unlike ones that we evaluate as clinicians daily, and patients more often than not have several risk factors and causes for their ocular surface disease. A tear osmolarity within normal range in DED patients can occur in lower severity meibomian gland dysfunction, conjunctival chalasis, epithelial basement membrane dystrophy or allergic conjunctivitis.

These objective data helped me provide a more targeted treated plan so I could make recommended interventions earlier on, instead of starting and layering with different Rx drops and lubrication.

SPEED	15
Recent autoimmune panel	RF elevated only ANA, SS-A, SS-B, CRP negative Sjo panel negative
Tear osmolarity	296, 302
Lids	Meibum 2+ thick OD, 1-2+ thick OS Minimal telangiectasis
Conjunctiva	1-2+ conjunctivochalasis
Cornea	No corneal staining

Figure 1. Objective diagnostics that review both signs and symptoms are important to “put it all together” in complex OSD patients. This patient demonstrates significant OSD symptoms with elevated SPEED score, MGD and CCH. In the setting of a normal tear osmolarity, targeted interventions to the MGD and CCH will likely be more beneficial to this patient’s care.

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Disclosure: Dr. Yeu has financial relationships with Alcon, AMO and Bausch + Lomb. She consults for TearScience and TearLab.

KNOW YOUR FEMTO

A solid understanding of a femtosecond laser’s capabilities and comfort with making adjustments to standard settings are key to success in complex cases.

Jared Younger, MD

Femtosecond lasers have elevated cataract surgery with more precision and customization. Laser manufacturers have put a great deal of effort into establishing standard settings that work for surgeons in most situations. Initial training shows new users how to toggle between a few preset combinations of parameters based on factors such as nuclear density and pupil size. This is very helpful when the surgeon is initially learning how to use the laser. But once a surgeon is comfortable using the device, the education shouldn’t stop: he or she should learn which settings can be customized to optimize the procedure.

Here, I describe three types of cases in which customizing the laser settings — and in some cases, pushing the laser to its limits — has helped me optimize laser treatments.

FULL SPEED AHEAD FOR WHITE CATARACTS

In the case of a white, intumescent cataract, there is significant risk that the pressure inside the capsule can alter the effect of the laser pulses as one proceeds with the capsulotomy, causing an incomplete opening or even capsular tags. A very rapid laser capsulotomy can help avoid such complications.

Every laser system is a little different, of course. On the Catalys laser (Johnson & Johnson Vision), the standard capsulotomy settings apply the laser pulses from a depth range of 600 µm, so there is a margin of treatment of 300 µm above and below the anterior capsule. For white cataracts, it is important to increase the pulse margins in case the capsulotomy disc moves anteriorly or posteriorly during creation. The following adjustments optimize the capsulotomy and also make it faster. I make the incision depth a little wider (700 µm), increase the vertical spacing in each column of laser spots by 50% (the horizontal spacing doesn’t change), and increase the pulse energy by 75%, from 4.0 µJ to 7.0 µJ (**Table 1**).

Table 1. Examples of capsulotomy settings for the Catalys laser
COURTESY JARED YOUNGER, MD

	INCISION DEPTH	HORIZONTAL SPOT SPACING	VERTICAL SPOT SPACING	PULSE ENERGY	CAPSULOTOMY TIME
Standard 5.0 mm	600 µm	5 µm	10 µm	4.0 µJ	1.6 sec
High energy for post-RK	500 µm	5 µm	13 µm	10.0 µJ	1.3 sec
White cataract 4.7 mm	700 µm	5 µm	15 µm	7.0 µJ	1.0 sec

Customized settings for femtosecond laser softening of a rock-hard cataract.

These adjustments speed up a 4.7-mm capsulotomy from an already fast capsulotomy to just one second, decreasing the chance that fluid pressure inside the lens will disrupt the capsulotomy during construction. If there is a suspicion that the intralenticular pressure is much higher than usual, one can decrease the capsulotomy size even further, which makes the treatment time well below one second.

POST-RK TREATMENTS

In an eye with a history of radial keratotomy (RK), the speed of the capsulotomy is less important than the ability of the laser to treat through those old radial scars. In such cases, I tighten the incision depth, but the most important boost is increasing the pulse energy to the maximum of 10 μ J (**Table 1**). Although I have read about concerns with femtosecond laser-related inflammation, I have treated a number of these post-RK patients now and have not seen any increase in postoperative inflammation, even with these higher energy settings.

Another feature of this laser, if a toric lens implant is planned, is its ability to place 10° arc-length intrastromal marks at the steep axis. Also, the laser's OCT imaging allows the surgeon to see the shadow of the RK scars and to manually rotate the incision axis tool on the touchscreen, to ensure that any planned arcuate incisions don't intersect with the scars. I have had success placing intrastromal laser astigmatic keratotomy (AK) incisions in between prior RK scars to treat small amounts of astigmatism, either with a single arc or asymmetric paired arcs (**Figure 1, page 32**).

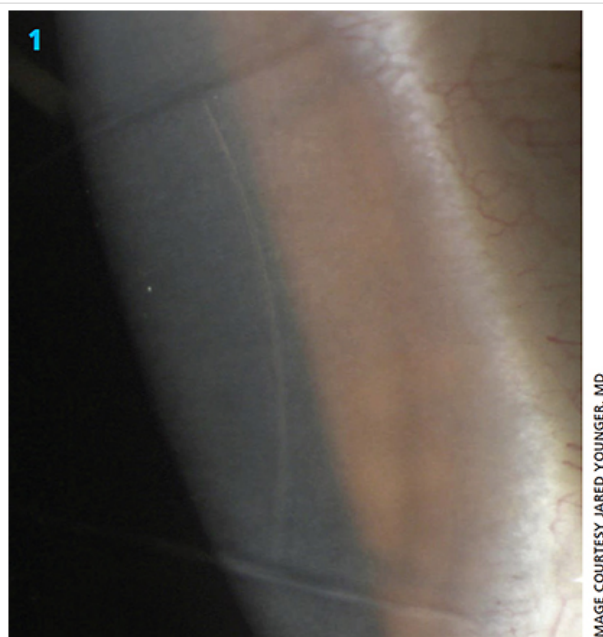


Figure 1. Manually adjusting the placement of AK incisions based on OCT imaging allows the surgeon to position AK incisions between old radial scars.

MAXIMUM FRAGMENTATION

Most lasers will have a preset option for dense nuclei, but in rock-hard, brunescant cataracts, it may be necessary to push the laser nearly to its maximum settings to achieve the desired softening. Like many surgeons, I don't perform lens fragmentation in all routine cases, relying simply on laser segmentation, making quadrants or (usually) sextants.

In about 10% of cases, I add grid fragmentation, typically set at 500 μ m seg-soft spacing and 500 μ m grid spacing, but it is important to note that this grid spacing can be adjusted from 100 μ m cubes (tightest grid and most softening) to 2,000 μ m cubes (least softening). In a recent brunescant cataract case, I went nearly to the maximum fragmentation, with a 200 μ m grid (**Figure 2, page 32**). In such a dense cataract, this laser treatment is not going to completely separate the lens into tiny cubes, but it can significantly reduce phacoemulsification time.



Figure 2. Fragmentation grid spacing is near the maximum in this brunescant cataract case. The change in settings increases the treatment time to 125 seconds in total, most of which is for fragmentation.

I also tightened the fragmentation vertical spot spacing, decreased the anterior capsule safety margin to 250 μm , boosted the anterior and posterior pulse energy, and increased the number of repetitions from two to three passes. These changes lengthened the fragmentation time from a typical 30 seconds to nearly 2 minutes, as shown in Figure 2, but ultimately made phacoemulsification feasible and avoided the need for an extracapsular surgery.

In summary, femtosecond lasers for cataract surgery have remarkable capabilities that can make challenging cases manageable and, in my opinion, safer, provided that surgeons know how to make the appropriate adjustments to facilitate each type of case. **OM**

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Disclosure: Dr. Younger is a consultant to Johnson & Johnson Vision.

A video detailing Dr. Younger's optimization techniques is [here](#).

Ophthalmology Management, Volume: 21, Issue: June 2017, page(s): 26-28, 30-33

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