

Glaucoma Laser Therapy

Clinical pearls from an experienced surgeon.

BY THOMAS E. BOURNIAS, MD

Modern glaucoma therapy requires the use of medications, laser procedures, and incisional surgery in order to achieve optimal IOPs for patients. Physicians perform laser procedures as alternatives to incisional procedures to lower pressure when medications either fail or are poorly tolerated. Laser therapy can also modulate filtration surgery (eg, performing suture lysis) in order to improve its success or to elevate IOP in cases of trauma to the ciliary body (eg, lasering a cyclodialysis cleft). This article describes techniques for commonly performed laser procedures used in the treatment of glaucoma patients.

PERIPHERAL IRIDOTOMY

The primary indication for performing a peripheral iridotomy (PI) is pupillary block. The clinical presentation may include an occludable angle, acute angle closure, fellow eye of angle closure, and mydriatic-induced angle closure. I begin the procedure by placing an Abraham lens (Figure 1A) on the anesthetized cornea. The lens features a 66.00-D button that maximizes the delivery of laser energy to the iris in the smallest possible area and thereby pro-

TECTS the cornea from damage.

The laser beam is focused superiorly on the peripheral iris (Figure 1B). The typical parameters for treatment with an Nd:YAG laser are 5 to 10 mJ, but the energy applied will depend upon the accuracy of the laser's calibration, the thickness of the tissue, and the precision of the treatment's focus. Ideally, full penetration is achieved in one to three applications. Darker and thicker irides generally require higher energies and more applications. An argon laser may be used to pretreat the area in cases of very thick irides or if the practitioner is concerned about potential bleeding (eg, uveitic eyes). Pretreatment with an argon laser involves a large spot size such as 200 μ m, 300 to 400 mW, and 0.2 seconds. The desired goal is to see contraction of the iris stroma and the formation of a "pit." The surgeon applies the burns in an overlapping configuration and then centrally completes the Nd:YAG laser iridotomy (Figure 2).

GONIOPLASTY

Goniotomy involves the placement of four to 10 treatment spots per quadrant in the peripheral iris (Figure 3). Indications for the procedure include a narrow angle after

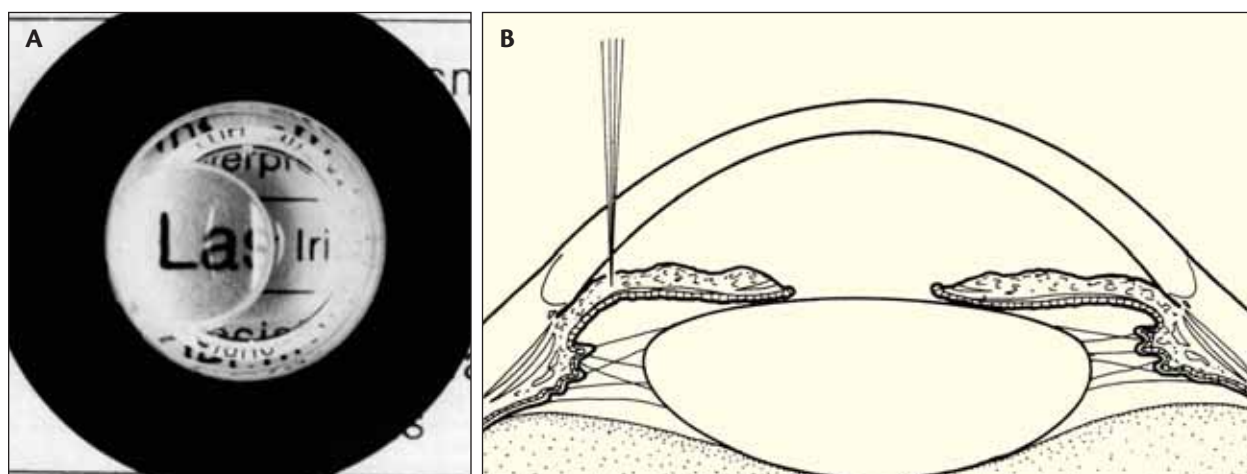


Figure 1. The author uses an Abraham lens (A) when applying laser treatment to the peripheral iris during PI (B).

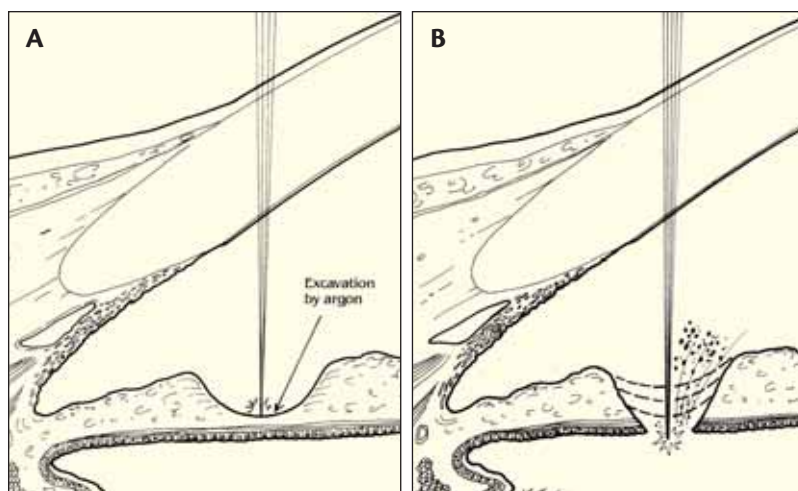


Figure 2. During laser PI, pretreatment with the argon laser forms a “pit” (A). The author completes the procedure with an Nd:YAG laser (B).

PI, the impossibility of performing PI, plateau iris, the facilitation of laser trabeculoplasty, and phacomorphic angle closure. I recommend using an argon laser and settings such as 200 to 500 μm , 100 to 600 mW, and 0.2 to 0.5 seconds. The reaction of the tissue determines the power and duration of treatment. One may consider beginning with settings of 200 μm , 200 mW, and 0.2 seconds and increasing the power until the tissue contracts. The procedure is usually performed with the gonioscopy mirror of a Goldman 3 mirror lens. The surgeon should aim the laser as far onto the peripheral iris as possible and titrate the settings as mentioned according to the reaction of the tissue. I treat patients with a topical anti-inflammatory for a few days postoperatively.

LASER SUTURE LYSIS

During trabeculectomy, placing sutures through the scleral flap can allow the regulation of aqueous flow to the bleb. If the postoperative IOP is too high with a deep anterior chamber or the bleb is fibrosing, laser suture lysis may be performed to increase the aqueous flow through the flap.

When performing trabeculectomy, I usually tie the flap with nylon sutures. When suture lysis is indicated, a lens such as a Hoskins lens (Figure 4) is placed over the anesthetized conjunctiva to help visualize the underlying suture and help protect the conjunctiva from thermal injury. In order to avoid prolonged hypotony, I generally avoid suture lysis on the first postoperative day. Instead, I perform digital ocular pressure to release any fibrin that may be blocking the filtration site. If the IOP is still too high and the anterior chamber is still well formed, I may proceed with suture lysis. I use an argon laser at 532 nm, 50 μm , 250 to 750 mW, and

0.1 seconds. This procedure may be performed for up to 2 weeks after surgery (up to 4 weeks if an adjunctive anti-fibrotic [eg, mitomycin C] has been used).

If there is noticeable subconjunctival hemorrhage (Figure 5) or conjunctival pigmentation around the area of the suture, the conjunctiva may absorb the laser energy and sustain thermal injury, because the absorption spectra of hemoglobin and melanin are approximately 532 nm (nearly the same as that of the nylon suture). In these situations, I recommend using a Krypton (red) laser, the energy of which is closer to 600 nm and has less chance of being absorbed by blood- or pigment-stained conjunctiva. I employ a Krypton (red) laser at

560 nm, 50 μm , 500 to 1,000 mW, and 0.1 seconds. A red diode laser (at 810 nm) is much less effective for lysing nylon sutures, because its absorption spectrum is well outside the optimal range for nylon sutures (Figure 6).¹

LASER PHOTOCOAGULATION OF CLEFT

Blunt trauma to the eye can damage the angle structures. Angle recession may result in elevated IOP and subsequent glaucomatous damage. Additionally, the ciliary body may become detached at the scleral spur and lead to hypotony whereby aqueous is shunted into the

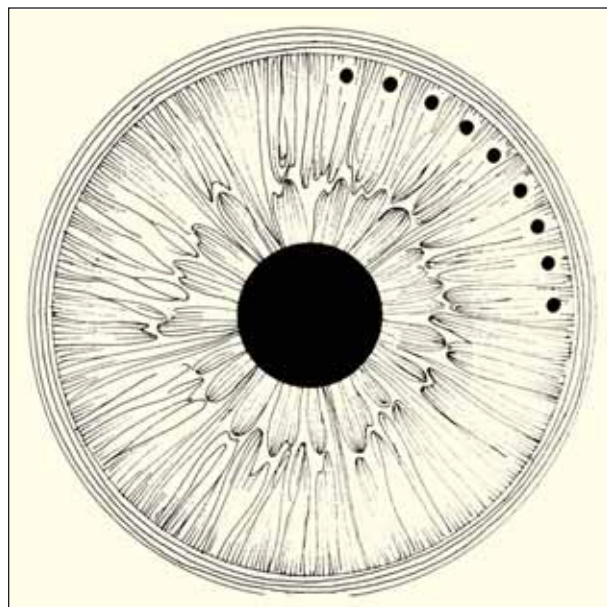


Figure 3. During gonioplasty, the author applies laser energy to the area depicted.

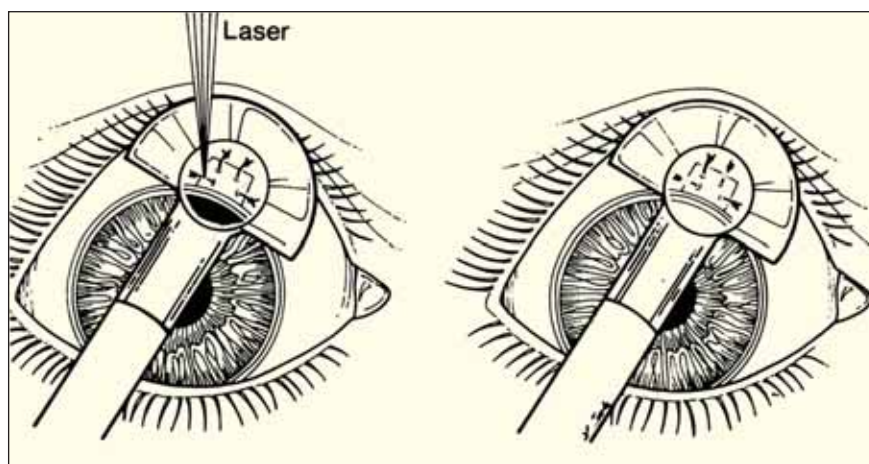


Figure 4. The author uses a Hoskins lens during laser suture lysis.

suprachoroidal space. If medical therapy does not resolve this situation, laser photocoagulation may successfully close the cleft and raise the IOP to a physiologic level. The numerous indications for cleft photocoagulation are pain, decreased vision, failed medical therapy, an IOP of less than 6 mm Hg, a shallow anterior chamber, aqueous cell/flare, induced hyperopia, cataract formation, corneal folds, chorioretinal folds/effusion, and the appearance of optic disc swelling.

I instill pilocarpine drops to cause the ciliary body to pull on the scleral spur, thus opening the cleft for subsequent photocoagulation. Using a mirrored lens, I first treat the sclera with contiguous rows of laser energy. The parameters used are argon laser at 50 to 100 μ m, 1 W, and 0.1 to 0.2 seconds. Next, I treat the undersurface of the choroid and ciliary body at 100 to 200 μ m, 1 W, and 0.2 seconds. Finally, I create a hemorrhage at the depth of the cleft using 50 μ m, 0.05 seconds, and at least 1.2 W.²

I prescribe atropine drops postoperatively to assist apposition of the scleral and ciliary body surfaces, and I avoid anti-inflammatory agents to assist in cleft closure. It is permissible to repeat cleft photocoagulation multiple times before considering surgery.

TRANSSCLERAL CYCLOPHOTOCOAGULATION

I consider cyclodestructive procedures for cases of neovascular glaucoma or for patients in whom multiple standard glaucoma operations have failed. I prefer diode transscleral cyclophotocoagulation over cryotherapy, because it generally produces less inflammation and pain and is associated with less risk of hypotony.³ Because both modalities can cause a loss of one to two lines of BCVA, they are often reserved for patients whose BCVA is 20/200 or worse. The indications for transscleral cyclophotocoagulation include failed trabeculectomy, a failed

aqueous shunt, neovascular glaucoma, aphakic glaucoma, and glaucoma after penetrating keratoplasty.

Traditional transscleral cyclophotocoagulation involves circumferentially applying the foot plate of the G-probe at the limbus (Figure 7) and making 18 to 24 treatment applications of 1,500 to 2,000 mW for 2 seconds each until an audible “pop” is heard. This technique has been associated with more pain, inflammation, and hemorrhage than the alternative “slow-burn” method. The “slow burn” technique is also more comfortable for the patient. The latter technique also seems to require fewer retreatments.

With the “slow burn” technique, I perform 24 applications over 360° at 1,250 to 1,500 mW and 3.5 to 4.0 seconds per application. These parameters result in approximately 5 J of energy per application. I then treat patients aggressively with a topical or a short-acting subconjunctival steroid. I often perform a paracentesis with a TB syringe and 30-gauge needle immediately before or after the procedure, because the procedure can produce an immediate elevation of already high IOP.

LASER TRABECULOPLASTY

Argon laser trabeculoplasty (ALT) has been employed to treat open-angle glaucoma since 1979.⁴ Surgeons have used the procedure as an adjunct to medical therapy and as initial treatment. In general, success rates have been esti-



Figure 5. When lysing sutures in the presence of subconjunctival hemorrhage (or conjunctival pigmentation), the author employs a Krypton (red) laser.

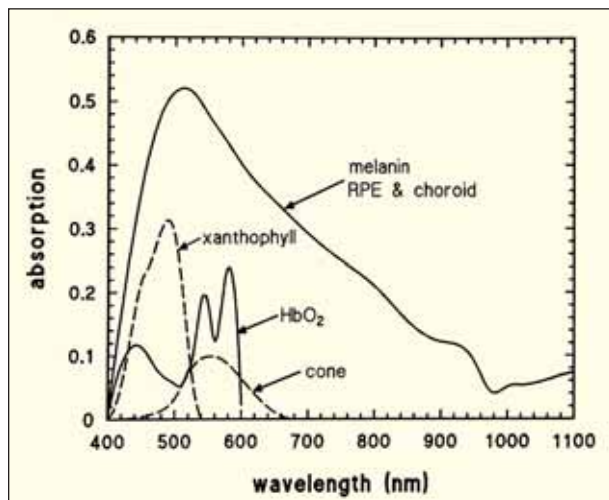


Figure 6. The absorption spectra for melanin and hemoglobin are similar to that of nylon sutures at approximately 532 nm.

mated to be approximately 80% at 1 year, 50% at 5 years, and 33% at 10 years.⁵ Disadvantages include poor repeatability⁶ and lower success rates in black patients.^{7,8} The parameters used are usually 50 μ m with 400 to 1,000 mW at 0.1 seconds. Recently, researchers described selective laser trabeculoplasty (SLT).⁹ This procedure has been efficacious, even in patients who had previously undergone ALT.¹⁰ SLT offers the advantage of no significant thermal effect at the trabecular meshwork, because the laser has a very low fluence (energy/area) and a short thermal relaxation time. As a result, the cells lining the trabecular meshwork remain intact, theoretically allowing for repeatability.

My starting energy is 0.8 to 1.0 mJ (more than the manufacturer-recommended starting point), because lower energies have resulted in more failures in my experience. The spot size is large at 400 μ m to keep the fluence very low, and the duration is extremely short at 3 nanoseconds. Of the more than 200 procedures I have performed, two-thirds have attained an IOP reduction of 3 mm Hg or more with a baseline of 20 mm Hg (average of 9 months of follow-up). Repeatability has been demonstrated, with 12 of 15 previous failures attaining at least a 3-mm Hg IOP reduction after a minimum of 6 months of follow-up. I often increase the energy at least 0.2 mJ for repeat procedures. Generally, I will use SLT (or ALT) as first-line treatment only in cases of pigment dispersion and pseudoexfoliation, because these procedures result in a more substantial IOP reduction in these entities. As primary therapies, ALT and SLT have not usually resulted in 25% to 30% IOP reductions (as do medications) in other types of open-angle glaucoma. ALT and SLT can, however, be quite reliable as adjunctive therapy.

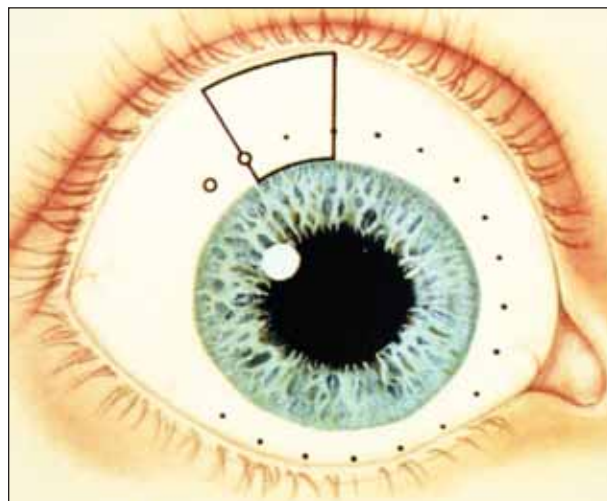


Figure 7. The traditional placement location of the G-probe's foot plate for diode transscleral cyclophotocoagulation is depicted.

CONCLUSION

Laser procedures are useful in many types of glaucoma at various stages. Surgeons can use them to enhance the outcomes of surgical procedures, as a means of foregoing more invasive procedures, or as adjuncts to or replacements for medical therapy. The proper applications of laser procedures can be critical to the preservation of vision in many glaucoma patients. Clinicians may greatly enhance patient outcomes by applying the appropriate parameters in various clinical applications. □

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