

Transscleral Cyclophotocoagulation

Technical advice and pearls for clinical practice.

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The goal of cycloablative procedures is to reduce IOP by destroying the ciliary body epithelium that produces aqueous humor. Early attempts at cyclodestruction involved methods such as cyclectomy, diathermy, ultrasonic energy, and cryotherapy. Although at times successful, these procedures resulted in relatively high rates of hypotony and other complications.¹⁻¹³ The earliest forms of cyclophotocoagulation utilized a xenon arc photocoagulator. Later forms of the procedure used lasers,¹⁴ including the Nd:YAG equipped with a sapphire-tipped contact probe as well as solid-state diode lasers equipped with disposable laser probes. The near-infrared diode laser has become the most widely used device for cyclophotocoagulation, and this discussion will focus on its use for transscleral cyclophotocoagulation of the ciliary processes.

INDICATIONS

Traditionally, surgeons have reserved transscleral cyclophotocoagulation for cases of advanced glaucoma in which maximal medical therapy is insufficient to control the IOP. Appropriate candidates for the procedure include patients in whom multiple filtering surgeries have failed, those deemed to be at high risk for complications after or the failure of filtering surgery (eg, individuals with aphakic glaucoma, neovascular glaucoma [NVG], or glaucoma after penetrating keratoplasty), and patients with low visual potential for whom an invasive procedure is not reasonable.

INFORMED CONSENT

Patients should be advised of the possible risks and benefits associated with transscleral cyclophotocoagulation. We begin by detailing the need for and risks of retrobulbar anesthesia, including pain, bleeding, infection, injury to the retro-orbital vessels and optic nerve, bruising, and periorbital swelling. We typically perform transscleral cyclophotocoagulation in the clinic without the benefit of monitored anesthesia care. Without proper discussion, the experience of a retrobulbar injection

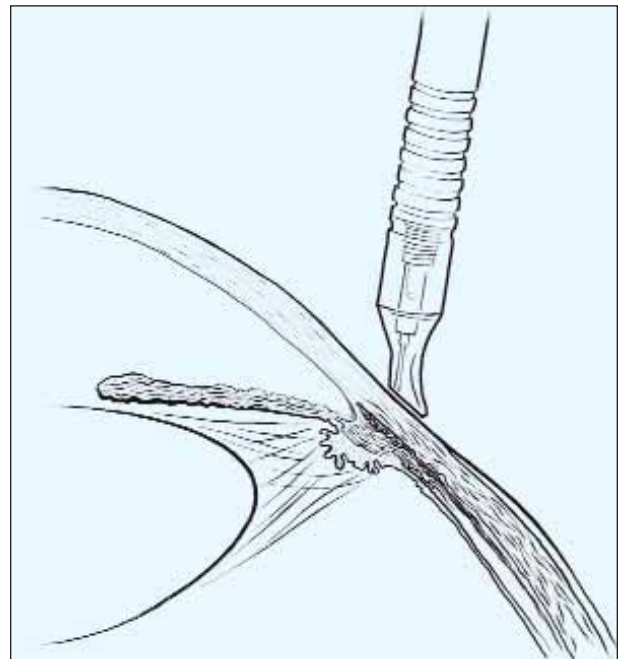


Figure 1. The G-probe is in position for the application of diode laser energy over the ciliary body.³

tion may be fairly traumatic for patients. They should be advised that additional injections may be required during the procedure to augment anesthesia and should be instructed promptly to alert the physician to any discomfort they experience.

The risk factors of transscleral cyclophotocoagulation include pain, bleeding, inflammation (acute and chronic), conjunctival burns, chemosis, subconjunctival hemorrhage, hyphema, progressive cataract, an atonic pupil, hypotony, IOP spikes, and a decrease in or loss of vision.

TECHNIQUE

The patient is reclined in an examination chair prior to receiving an anesthetic injection. The retrobulbar injection consists of a 50:50 mix of 2% lidocaine and

0.75% bupivacaine with or without hyaluronidase. The surgeon places a speculum to provide adequate exposure to the limbal area and applies balanced salt solution to moisten the ocular surface. The ophthalmologist may use a cotton-tipped applicator to rotate and stabilize the eye as needed during the procedure.

We use an 810-nm diode laser (Iris Medical Instruments Inc., Mountain View, CA) set initially at a duration of 2,000 milliseconds and a power of 2,000 mW for the first application. It is important to inspect the G-probe prior to its use, because chipped or defective tips may cause conjunctival injury or the suboptimal transmission of energy. We position the probe at the limbus and ensure that the footplate is in complete contact with the ocular surface. To properly transmit energy, we apply mild pressure to indent the conjunctiva and sclera (Figure 1). We move the footplate circumferentially by one half the probe's width after each application of laser energy. Traditionally, the three- and nine-o'clock positions are spared to avoid trauma to the long posterior ciliary vessels and nerves.

Usually, we increase the power of each application of laser energy by 250 mW until an audible "pop" is heard, which indicates an overtreatment of the underlying tissue. At this point, we decrease the power by 250 mW and complete the treatment at a setting near threshold. Each quadrant can accommodate five to six spots, allowing for a total of 20 to 24 spots with a 360° treatment. Care must be taken constantly to wet the ocular surface, or overheating and burning of the conjunctiva and underlying tissues may occur.

POSTOPERATIVE CARE

After the procedure, we instill a single drop of prednisolone acetate 1% and atropine 1% and then patch the eye overnight. One may prescribe a steroid and/or antibiotic ointment for additional comfort during the patching period. We typically see our patients on the first postoperative day to remove the eye patch and examine them for possible fluctuations in IOP and procedure-related side effects. We then prescribe prednisolone acetate drops at a frequency of four to six times per day along with a cycloplegic drop (atropine or cyclopentolate) two to four times per day. The preoperative topical and oral ocular hypotensive medications should be tapered as dictated by the patient's postoperative response. If a patient's postoperative IOP is greater than 20 mm Hg, we will continue all topical medications until the 1-week follow-up visit, after which they are slowly tapered. We instruct patients to discontinue their oral medications. Steroid and cycloplegic drops are tapered slowly as dictated by serial examinations for persistent inflammation and patients' comfort. They often remain on topical steroid therapy for 4 weeks or more.

OUTCOMES

It is difficult to interpret outcome measures after transscleral cyclophotocoagulation due to differences in patient populations and definitions of success as well as the lack of a sufficient number of subjects in prospective, randomized studies. Bloom and colleagues performed a retrospective review of 210 eyes undergoing initial or repeat (18%) cycloablation with cyclophotocoagulation.¹⁵ The preoperative diagnoses included NVG, traumatic glaucoma, aphakia, and silicone-oil-induced glaucoma. Decreases in vision were noted in 28% of treated patients and were more common in those with NVG and silicone-induced glaucoma. Graft failure occurred in 9.5% of patients with preexisting penetrating keratoplasties.

In a prospective, randomized study, Youn and colleagues compared noncontact transscleral cycloablation with an Nd:YAG laser and contact transscleral cycloablation with a diode laser.¹⁶ The follow-up period was short (10.4 ± 3.16 months), and the laser-related parameters were loosely defined. Success, defined as an IOP between 5 and 20 mm Hg, was achieved in 83% of the Nd:YAG-treated patients and 71% of the diode-treated patients. Five subjects (17%) in the Nd:YAG group and nine (26%) in the diode group experienced some degree of vision loss, although 57% of all patients were enrolled with vision of 20/400 or worse. Four patients in the diode group, three of whom were diagnosed with NVG, progressed to no-light-perception vision.

The Diode Laser Ciliary Ablation Study Group reported on a prospective, noncomparative case series involving 27 eyes of 27 patients with no previous cyclophotocoagulation procedures.¹⁷ The laser settings were 1,750 mW titrated up by 250 mW until an audible "pop" was heard, followed by a decrease of 250 mW to complete the treatment. Subjects underwent 270° treatment using a total energy of 63.3 ± 7.25 J. The investigators defined failure as either a reduction in IOP of less than 20% or an IOP greater than 22 mm Hg. The cumulative probability of success using both criteria for it was 72% at 1 year and 52% at 2 years; 41% of patients had IOPs of less than 22 mm Hg for the duration of follow-up. Complications included a loss of vision (30%), burns to the conjunctival surface (33%), and hypotony (3.7%).

COMPLICATIONS

Although studies have demonstrated the relative safety and efficacy of transscleral cycloablation for various forms of glaucoma, significant rates of postoperative complications still exist, including pain, inflammation, hyphema, fluctuations in IOP, and, in some cases, a loss of vision.¹⁸⁻²²

Ophthalmologists usually control the pain associated with transscleral cycloablation with mild analgesics such as acetaminophen or ibuprofen. Some patients may need potent pain medications during the first few postoperative days. An acute iridocyclitis with accompanying pain and photophobia may occur as a consequence of the blood-aqueous barrier's breakdown. Topical steroids and cycloplegic agents are usually sufficient for treatment, although a chronic reaction of low-grade anterior chamber cell and flare may persist in a subset of patients. Long-term topical steroid therapy is not required in these cases, because the problem results from a breakdown of tissue barriers and not a true iridocyclitis.

Conjunctival burns are an infrequent complication of transscleral cycloablation and can be avoided with the proper application of laser energy, wetting of the conjunctiva, and inspection of the G-probes prior to their use. G-probes should be discarded after five treatment sessions (100 to 125 applications of laser energy) or when defects of the tip are noted.²³ Burnt tissue is treated with observation, topical steroids, and/or lubricating ointments.

IOP spikes occur in a small percentage of patients and can typically be controlled with medical therapy. Contreras and colleagues reported on changes in IOP after transscleral cycloablation in 116 eyes (110 patients) with refractory glaucoma.²⁴ The investigators stated that 10.8% of the treated eyes experienced an IOP spike, most frequently those with NVG. This report provides another reason to examine patients on the first postoperative day, because instituting prompt medical therapy can avoid the further loss of visual field and decrease patients' discomfort associated with fluctuations in IOP.

Hypotony after transscleral cycloablation remains a risk in a certain subset of patients. Specifically, those with NVG appear to be predisposed to this complication, and it may occur more frequently in patients who have had a pars plana vitrectomy. Long-term topical steroids, cycloplegia, and the elimination of other causes of chronic hypotony such as retinal detachment and/or choroidal detachments are indicated. Unfortunately, some eyes suffer from decreased vision due to chronic hypotony and may become phthisical and/or require enucleation.

Vision loss after transscleral cycloablation is a major concern for both the patient and the physician. In one study of visual outcomes after transscleral cycloablation in 27 eyes with severe glaucoma, one eye with light-perception vision had no light perception after treatment, three eyes lost two lines of vision, and five lost three or more lines.¹⁷ In a prospective evaluation of the efficacy of

transscleral cycloablation as primary therapy for patients with primary open-angle glaucoma, Egbert and colleagues found that visual acuity decreased in 18 (23%) of 79 eyes treated with transscleral cycloablation versus 10 (23%) of 47 fellow eyes treated with glaucoma medications alone.²⁵ Ansari and Gandhewar retrospectively evaluated the long-term efficacy and safety of transscleral cycloablation for a range of glaucomatous conditions and performed a subanalysis of patients with vision of 6/36 or better.²⁶ They reported that three of 23 (13%) patients with primary open-angle glaucoma lost vision due to progressive cataract and glaucoma. Eight patients diagnosed with chronic angle-closure glaucoma did not show any significant deterioration in vision.

Ophthalmologists lack a clear understanding of the incidence and cause of visual deterioration after transscleral cycloablation. The complication may be due to advancing cataracts, improper control of patients' IOP, and/or chronic hypotony. Cystoid macular edema is also theorized to be a major cause of vision loss. Appropriate studies are not available, however, to verify these hypotheses. Other possible causes of vision loss include sympathetic ophthalmia, malignant glaucoma, and necrotizing scleritis.²⁷⁻³⁰

CONCLUSION

Transscleral diode cyclophotocoagulation is an effective surgical procedure for glaucoma that is refractory to maximal medical therapy and/or previous penetrating surgery. Proper patient selection and surgical technique help to minimize the procedure's known side effects and improve its long-term success. Treating physicians must be familiar with the nuances of the laser device and G-probe, and they must remain vigilant for complications during both the peri- and postoperative periods. Future devices may incorporate direct real-time imaging capabilities that could improve both the safety and efficacy of noninvasive cycloablative procedures.³¹ □

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