

Laser Management: The Future of Optometry

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ABSTRACT

This review discusses how to identify patients who require an argon laser trabeculoplasty (ALT), a laser peripheral iridotomy (LPI), or a laser capsulotomy; and how to perform and manage these routine laser procedures. These laser procedures are relatively safe with few risks and complications when properly performed and managed. The skills and knowledge required to perform the procedures are within the scope of optometry.

The profession of optometry continues to rapidly grow not only in the scope of practice, but also in the responsibility as the primary eye care provider. With the passage of TPA bills across the nation, optometry has accepted the challenges of treating glaucoma and other anterior segment diseases. Therefore, it becomes vitally important that all optometrists exercise and maintain proficiency and expertise in all available treatment modalities to provide optimal patient care.

Argon laser trabeculoplasty (ALT) and laser peripheral iridotomy (LPI) are relatively common and routine procedures used in glaucoma treatment. Along with laser capsulotomies, these laser procedures if done properly have few risks and complications. Therefore, with proper training and education, the future of optometry could include laser surgeries of the anterior segment. In fact, many Oklahoma optometrists and Northeastern State University Optometry School graduates are becoming laser certified and legally performing laser procedures. This may be a unique example due to the rural nature of Oklahoma, however, on the eve of health care reform, optometry may be called upon to accept a larger role in the delivery of primary health care because of the profession's unique training and affordability. "Within ten years, lasers will be an integral part of patient management. It's almost impossible for optometry not to be involved," J. James Thimons, O.D. (Glenn, 1991, page 33) The scope of this paper will describe the basic techniques of ALT, LPI, and capsulotomies and help identify conditions which are indicative for surgery; complications and contradictions; and the recommended post-operative patient management.

Eighteen to fifty percent of patients who undergo an extracapsular cataract extraction (ECCE) or posterior chamber intraocular lens surgery develop visual debilitating secondary

membranes after five years. (Apple & et al., 1992) Nearly all children will develop secondary membranes within two years of their surgery. (Apple & et al., 1992) The opacification of the posterior capsule is due to the proliferation of lens epithelium. With a biomicroscope, secondary membranes are best viewed by binocular retroillumination through a dilated pupil. (Weingeist, 1992)

The laser capsulotomy has replaced surgical discission as the standard of care for secondary membranes of the posterior capsule in aphakes and pseudophakes. (Kimiharu, Shimizu, & Trokel; 1992) The photodisruptive neodymium-YAG (Nd: YAG) laser is the laser of choice for this procedure. The goal of the laser capsulotomy is to create an opening through the opacified capsule to relieve the patient from their symptoms and to provide the examiner with a better view of the fundus. During laser procedures, patients report decreased vision, increased glare, loss of contrast sensitivity, and photophobia. (Carr, 1993; Weingeist, 1992)

A laser capsulotomy is indicated when the secondary membrane impairs or interferes with the everyday visual needs of the patient. (Carr, 1993; Weingeist, 1992) Thus, indications for a laser capsulotomy are the same as for a cataract extraction. Guidelines for medicare reimbursements require visual acuity of 20/50 or worse. (Carr, 1993) Leland Carr, O.D., described the following reasons for decreased vision following cataract surgery and how to identify the visual loss which indicates formation of a secondary membrane and laser management:

1. Immediate blurred vision is most often caused by remnants of lens cortex which takes three to six months to resorb.

2. Sudden drop in vision following a period of good vision is most likely caused by cystoid macular edema (CME).
3. A period of excellent vision followed by a gradual loss of vision over a three to six month course.

According to Carr, the patient who experiences the third example has developed a secondary membrane and is the ideal candidate for a laser capsulotomy. The laser capsulotomy is contraindicated in patients with an acute intraocular inflammation; a vascularized membrane across the posterior surface of the IOL; and soft silicon IOL's less than six months old. (Carr, 1993)

Before performing the laser capsulotomy, the refractive status and visual potential of the patient should be determined by a refraction and potential acuity meter (PAM) or laser interferometer to predict success. (Carr, 1993; Kimiharu, Shimizu, & Trokel, 1992) Also required is a thorough assessment of the ocular health including the opacification to evaluate the membrane thickness and tension lines using the biomicroscope. (Carr, 1993) Prior to dilation, the pupil position should be noted since the pupil will often decenter following dilation. (Carr, 1993; Kimiharu, Shimizu, & Trokel, 1992)

One hour before surgery, a drop of apraclonidine or a beta-blocker is instilled to decrease the risk of an intraocular pressure spike. A topical anesthetic may be used to decrease the blink reflex. Also, a special capsulotomy contact lens along with Gonisol may be used to stabilize lid and eye movements and increase energy at a small focal spot. (Kimiharu, Shimizu, & Trokel, 1992) Laser applications are started in the midpupillary area. Several different pattern techniques are used to create the opening. The goal is to

create a three to four millimeter nearly round "window" which is coincidental with the center of the undilated pupil. (Carr, 1993) During laser surgeries, patients often experience sparkles, brief flashes or fireworks along with sounds of snaps and pops. (Carr, 1993)

Complications of a laser capsulotomy include: 5-10 mmHG rise in IOP (30-60%); retinal detachments (1-2%); mild iritis; transient corneal burns; pitting and tiny cracks of PMMA and soft silicon IOL's; and vitreal prolapse into the anterior chamber. (Carr, 1993; Weingeist, 1992) Since elevated IOPs and/or uveitis are common, immediate post-operative management begins with apraclonidine or a beta-blocker. Intraocular pressures are checked after ninety minutes to see if further medical therapy is required to lower an IOP spike. A beta-blocker is prescribed b.i.d. for seven days to normalize IOP. To treat mild uveitis, prednisolone acetate 1% is prescribed q.i.d. for seven days. (Carr, 1993) Pitting of IOL's rarely result in visual disturbances. Because of the retinal detachment risk, the patient is educated about its signs and symptoms. The patient is re-examined one week later for a complete eye exam or sooner if they notice pain or a red eye. High risk patients are examined the following day. (Carr, 1993)

Primary angle closure glaucoma (ACG) is responsible for less than 10% of all diagnosed cases of glaucoma. (Jackson, 1994) Early detection and diagnosis allows prevention of rapid visual loss often associated with primary ACG. The risk factors for primary ACG include: caucasian, positive family history, 6th-7th decade of life, female, and hyperopia. (Jackson, 1994)

There are three types of primary ACG: acute, subacute, and chronic. Acute ACG

is a true ocular emergency which results in vision loss if medical treatment is not begun immediately and appropriately. (Jackson, 1994) The symptoms of an acute attack are redness, pain, blurred vision, rainbow colored halos, headache, nausea, and vomiting. Clinical signs include: unilateral fixed mid-dilated pupil, corneal edema, high IOP (40-90 mmHg), red eye, and shallow anterior chamber with inflammation. (Schanzer, 1995) Subacute ACG is characterized by intermittent episodes of angle closure that resolves spontaneously. Symptoms may vary with each patient and IOP level. Each subsequent intermittent attack increases the patient's symptoms and their risks for developing an acute attack or chronic ACG. Chronic ACG is most often asymptomatic, therefore, diagnosis is made by gonioscopy, optic nerve evaluation, and visual field changes. The permanent rise in IOP and optic nerve damage is secondary to the slow formation of peripheral anterior synechiae (PAS) around the anterior chamber angle. (Jackson, 1994)

The diagnosis of primary ACG requires a thorough assessment of the patient's case history, specifically, symptoms and family history, and ocular health. The comprehensive ocular health exam should include angle evaluation by gonioscopy, stereoscopic optic nerve evaluation with 78 or 90 D lens, and baseline optic nerve photographs and visual fields. Provocative testing may also be done to determine high-risk patients for ACG. The use and value of provocative tests are controversial amongst glaucoma specialists. The differential diagnosis of primary ACG includes: Plateau iris syndrome, iridocorneal endothelial syndrome (ICE), malignant glaucoma, early neovascular glaucoma, and glaucomatocyclitic crisis. (Jackson, 1994)

The laser peripheral iridotomy (LPI) is the standard of care for primary angle closure

glaucoma conditions caused by pupillary block. The goal of the iridotomy is to create an opening in the iris for the aqueous to flow from the posterior to the anterior chamber which results in a deeper anterior chamber and opens the angle. The use of lasers avoids the risks of intraocular surgery and use of retrobulbar or general anesthesia. (Kanski & McAllister, 1989) Other indications for the use of an LPI include: prophylactic treatment of narrow angles and fellow eye of an acute ACG; diagnosis of plateau iris syndrome and malignant glaucoma; and prior to laser trabeculoplasty to visualize angle structures in mixed-mechanism glaucoma. (Cairns, 1986; Drake, 1987; Kanski, 1989; Kimiharu, Shimizu & Trokel, 1992; Weingeist, 1992) LPI's are contraindicated in patients with angle closure secondary to neovascularization; inflammatory synechiae, ciliary body swelling; corneal edema; ICE syndrome; shallow anterior chamber; and angles closed over 180 degrees by PAS.

For an acute ACG, appropriate medical therapy should be used to break the attack before considering a LPI. It is best to perform the LPI 48-72 hours after an acute attack to assure that there is no corneal edema or swelling. (Kanski, 1989) If medical therapy cannot break the attack, a LPI is performed after the cornea is cleared with topical glycerin.

The argon and/or Nd:YAG laser may be used to perform a LPI. In recent years, the Nd:YAG laser has become the laser of choice because of its many advantages over the argon laser. The Nd:YAG laser can penetrate all iride colors; requires fewer applications which is safer and preferred by patients; has a higher success rate for penetration and patency; and causes a smaller inflammatory response. (Kanski, 1989) The Nd:YAG laser will cause a small hemorrhage in 35-40% of the cases. (Cairns, 1986; Drake, 1987;

Weingeist, 1992) This bleeding rarely results in a hyphema and is easily controlled with direct pressure on the contact lens. For thick and darkly pigmented irides, surgeons may elect to use an argon laser to thin the iris stroma then use the Nd:YAG to complete the penetration. (Kimiهارu, Shimizu & Trokel, 1992; Weingeist, 1992)

Prior to performing a LPI, 2-4% pilocarpine and apraclonidine are instilled one hour before the surgery. Both medications reduce the risk of an acute post-operative IOP rise. The miosis created by pilocarpine thins the iris which allows for easier penetration. Topical anesthetic is instilled immediately before the LPI. (Kimiهارu, Shimizu & Trokel, 1992; Weingeist, 1992)

The ideal location for the iridotomy is at the junction of the middle and outer thirds of the iris at the 10:00 or 2:00 position under the upper eyelid. (Kanski, 1989; Weingeist, 1992) Placement of the iridotomy underneath the upper lid prevents an artificial pupil which would be a source of monocular diplopia, glare and photophobia. (Kimiهارu, Shimizu & Trokel, 1992) The superonasal quadrant is the preferred site to avoid macular damage. (Weingeist, 1992) Iris crypts are a good target since they represent an area of thin iris. (Weingeist, 1992) Areas of arcus senilis are avoided to prevent corneal burns and loss of laser power. (Cairns, 1986; Weingeist, 1992)

Penetration is achieved when a dust cloud of fine pigment bursts into the anterior chamber. Following the 'mushroom cloud,' the iris stroma floats backwards and the anterior chamber deepens. (Cairns, 1986; Kimiهارu, Shimizu & Trokel, 1992) Following the laser iridotomy, IOP's are successfully controlled in angle-closure glaucoma (80%), mixed-mechanism glaucoma (86.8%), and narrow-angle glaucoma (87.4%). (Shingleton, Richter

& Dharma, 1993) Within three months, twenty to thirty percent of iridotomies require a second treatment due to closure of the iridotomy. (Drake, 1987) Inflammation and/or circulating debris may cause an immediate closure of the iridotomy. Another reason for immediate closure is the landsliding-effect which is when pigment epithelium above the iridotomy slides over the opening. Delayed closure of the iridotomy is caused by localized pigment proliferation or formation of a thin, transparent membrane. (Cairns, 1986) The iridotomy is patent when either the lens capsule or zonules are visible. (Weingeist, 1992) A red reflex does not ensure patency because of the possibility of the transparent membrane. (Weingeist, 1992)

Following the LPI, forty percent of the patients experience an increase of at least 6 mmHg in IOP within the first hour. (Cairns, 1986) The IOP peaks at 1-3 hours after the procedure. (Drake, 1987) Therefore, a second drop of apraclonidine is immediately instilled following the procedure and IOP's are monitored for 2-3 hours. (Drake, 1987) If pressures remain elevated, aggressive glaucoma is indicated until pressures are normalized. Other possible complications of the LPI are transient blurred vision; transient corneal epithelial or endothelial opacities; non-progressive punctate lenticular opacities; retinal damage; hemorrhage (Nd:YAG); and a transient iritis. (Cairns, 1986; Drake, 1987)

Upon discharge, patients are prescribed topical prednisolone 1% q.i.d. for four days for the mild anterior uveitis. Patients are to continue their preoperative glaucoma medications. To prevent closure of the iridotomy, doctors will prescribe pilocarpine for several weeks. (Kanski, 1989) The patient is reexamined at one day, one week, one month, two months, six months, one year, then annually. At the follow-up exams, the examination

should include tonometry, gonioscopy, evaluation of patency, and stereoscopic evaluation of the optic nerve. Photographs and visual fields are done every 1-2 years. (Jackson, 1994)

Argon laser trabeculoplasty (ALT) is the photocoagulation treatment of the trabecular meshwork. The goal of the procedure is to lower the IOP in primary and secondary open angle glaucoma. The mechanism for lowering the IOP is not fully understood, but some believe that resulting collagen shrinkage decreased the trabecular ring diameter which pulls on neighboring meshwork to open spaces to increase aqueous outflow. Also, it has been postulated that biologically activated endothelial cells clean the drainage area by phagocytosis. (Kanski, 1989; Schanzer, 1995; Richardson, 1992; Weingeist, 1992; Kimiharu, Shimizu, & Trokel, 1992; Carr, 1993) ALT successfully lowers IOP by 20-30% (7-13 mmHg) in 80% of POAG patients. (Carr, 1993; Weingeist, 1992) The long-term success is 45% after five years and 32% after ten years. (Schanzer, 1995; Cairns, 1986; Richardson, 1992; Shingleton, 1993) The greatest percent of failures (23%) occur during the first year. (Shingleton, 1993)

Historically, ALT has been reserved as an alternative to filtration surgery for those patients with uncontrolled POAG despite maximal medical therapy. Currently, the Glaucoma Laser Trial Research Group (GLTRG) is studying the efficacy and safety of ALT as the initial treatment of POAG. They have found that after two years, IOP was controlled in 44% of laser-only eyes versus 30% of medication-only eyes (Timoptic .5%). (GLTRG, 1990) Also, IOP was controlled in 89% of laser-first eyes with additional medication therapy. The mean IOP in laser-first eyes was consistently 1-2 mmHg lower. There were

no major differences in visual field changes between the two treatments. (GLTRG, 1990) The initial finding of the GLTRG are promising, but more research is needed to support this alternative treatment method.

ALT is indicated in medically uncontrolled POAG; non-compliant, disabled, or handicapped patients; failed filtering operation; primary or secondary glaucoma; and possibly for higher IOP levels in low-tension glaucoma. (Weingeist, 1992; Kanski, 1989; Kimiharu, Shimizu, & Trokel, 1992) The best candidates are over age 40; phakic or pseudophakes; pretreatment IOP's between 20 and 29 mmHg; and those with documented optic nerve damage. (Carr, 1993; Cairns, 1986) Long term success is greater in whites (65%) versus blacks (32%). (Cairns, 1986) ALT is very effective for both pigmentary and pseudoexfoliation glaucoma. (Kimiharu, Shimizu, & Trokel, 1992)

ALT is contraindicated in a cloudy cornea or anterior chamber; non-visible trabecular meshwork; active ocular inflammation; patients below age 25; blood in anterior chamber; and following a previous failed 360 degrees ALT. (Kanski, 1989; Kimiharu, Shimizu, & Trokel, 1992) To visualize the trabecular meshwork, a LPI may be performed 24 hours before the ALT. ALT is ineffective in congenital/juvenile glaucoma; uveitic or neovascularization glaucoma; and angle recession or angle closure glaucoma. (Weingeist, 1992; Kimiharu, Shimizu, & Trokel, 1992; Cairns, 1986)

As with the capsulotomy and LPI, apraclonidine is instilled one hour before the ALT. The inferior 180 degrees angle is treated first because it is the widest, most pigmented, and contains the clearest landmarks. (Weingeist, 1992) The laser is focused at the junction of the non-pigmented and pigmented trabecular meshwork. (Kanski, 1989; Weingeist, 1992;

Kimiharu, Shimizu, & Trokel, 1992; Carr, 1993; Thimons, 1991; Cairns, 1986) Aiming posteriorly to this target may result in pain, inflammation, and/or synechiae formation. (Weingeist, 1992) The application spot is successful when a faint white clouding or a small air bubble is noted. (Kimiharu, Shimizu, & Trokel, 1992) Fifty spots are applied at regularly spaced intervals between the three o'clock and nine o'clock positions by continually rotating gonioscopes and aiming through its center to avoid loss of orientation. (Kanski, 1989; Weingeist, 1992; Kimiharu, Shimizu, & Trokel, 1992; Carr, 1993) The superior portion may be treated one to four weeks later to prolong effect and 'drift.' (Carr, 1993)

Immediately after the LPI, one drop of apraclonidine is instilled. IOP's are regularly monitored over the next three hours because 50% of patients experience a transient (10 mmHg) rise in IOP. (Cairns, 1986) If IOP's are over 30 mmHg, treat aggressively with miotic and beta-blocker. (Kanski, 1989) If pressures continue to rise, institute osmotic agents or carbonic anhydrase inhibitors. (Kanski, 1989; Weingeist, 1992) If IOP's are not elevated after three hours, the patient is prescribed 1% prednisolone acetate q.i.d. for seven days, and they are to continue their preoperative glaucoma medications. (Kanski, 1989; Carr, 1993) The patient is recalled at one day and one week to measure IOP and evaluate possible uveitis. (Cairns, 1986; Kanski, 1989; Carr, 1993) Other complications encountered are PAS (22-46%) which can be avoided with good aiming technique; hemorrhages which are controlled with direct pressure on gonioscopes; insignificant and transient corneal burns; and CME in aphakes. (Weingeist, 1992; Cairns, 1986)

The effectiveness of the ALT is determined at 4 to 6 weeks by measuring the IOP's and evaluating the ocular health. If the IOP is below the target IOP level, the doctor may

consider reducing the number of glaucoma medications ideally the least tolerant and/or most expensive. (Cairns, 1986; Carr, 1993) Five to thirty-five percent are able to be removed from all medications. (Schanzer, 1995) If the IOP remains elevated after 180 degrees ALT, the doctor may elect to complete the remaining 180 degrees. However, retreatment of 360 degrees ALT is not recommended because 38-40% have a permanent IOP increase which may require a filtering procedure with 6 months. (Weingeist, 1992; Carr, 1993)

The skills required to perform the described laser procedures include: accurate focusing with the slit lamp; proficiency with gonioscopy; ability to correctly identify landmarks of the anterior chamber angle; and the knowledge and license to treat elevated IOP. These are basic skills well within the scope of optometric practice. Therefore, optometrists do have the ability and knowledge base to acquire skills in these relatively safe and effective laser procedures. To participate in the future of laser management, which provides many clinical challenges and rewards, optometrist must prepare by obtaining laser certification training and hospital privileges. Other challenges include facing another legislative battle to gain the right to perform the procedures; and receiving insurance reimbursements after performing the procedures. Fortunately, optometry has faced similar challenges in the past with great success. Therefore, optometrists are prepared to prove their knowledge and ability to perform these laser procedures as the primary eye care providers.

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