

SELECTIVE LASER TRABECULOPLASTY: A COMPREHENSIVE TREATMENT SOLUTION FOR GLAUCOMA

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A highly effective approach for first-line glaucoma treatment, as adjunct therapy with drugs, and as alternative therapy when drugs or surgery fail, selective laser trabeculoplasty (SLT) has become an essential tool in the glaucoma treatment armamentarium. According to Savak Teymoorian, MD, MBA, a cataract and glaucoma specialist at Harvard Eye Associates, California, the use of SLT as a primary therapy has slowly taken hold since its US introduction in 2001. Today, an increasing number of glaucoma specialists and general ophthalmologists view SLT as a viable alternative to medications in patients with newly diagnosed glaucoma.

In open-angle glaucoma (OAG), persistent raised intraocular pressure (IOP) arising from aqueous humor build-up secondary to trabecular meshwork degeneration and obstruction, damages the optic nerve resulting in visual field loss. Fortunately, there is an array of treatments available to help lower IOP and thus minimize further deterioration of the patient's vision.

Previously, surgeons had to rely on medical therapy at one end of the treatment spectrum and penetrating, bleb-dependent procedures such as trabeculectomy and tube shunts at the other. In recent years, however, treatment options have expanded and now include Minimally-Invasive Glaucoma Surgery (MIGS) and laser procedures, such as selective laser trabeculoplasty (SLT). SLT has been shown to lower IOP as effectively as medication, and to offer a consistent safety profile. Best of all, it is efficacious at every stage of the glaucoma treatment algorithm. A highly effective primary therapy option, especially in non-compliant patients, SLT can also reduce the number of medications required to control IOP.

SLT: Stimulating a Natural Healing Response – Without Thermal Damage

For over 30 years, argon laser trabeculoplasty (ALT) was the laser procedure of choice for OAG², with studies such as the 1998 Glaucoma Laser Trial confirming that ALT can effectively reduce IOP.³ Unfortunately, ALT requires the use of a high-energy

argon laser, which inflicts significant damage to surrounding trabecular meshwork tissue.

Invented by Mark A. Latina, MD, SLT is an advanced, non-thermal laser therapy that works by stimulating a natural healing response in the eye to manage IOP. Utilizing nanosecond laser technology, SLT promotes cellular regeneration without the burn and scar tissue associated with ALT.

SLT is performed with a Q-Switched frequency-doubled (532 nm) Nd:YAG laser, such as the Tango™ SLT/YAG laser from Ellex (www.ellex.com). This laser selectively targets melanocytes in the pigmented trabecular meshwork with 1/6000th of the flux density of ALT. SLT does not create a physical opening within the meshwork. Instead, SLT induces a local inflammatory response in which cytokines are released, macrophages are recruited and IOP falls.⁴ Moreover, as the cold laser used in SLT targets pigmented cells only, by a process called selective photothermolysis, it does not cause thermal or coagulative damage like ALT.⁴

SLT is Safe, Effective and Repeatable

Numerous studies have shown that SLT is similarly efficacious to medical therapy. A 2015 meta-analysis that included five studies and a total of 492 eyes with OAG found that SLT

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and topical medication demonstrated similar success rates and effectiveness in lowering IOP.⁵ Published evidence also indicates that the efficacy of SLT is at least comparable to ALT. In 2015, Wong et al published findings from a meta-analysis that included four randomized controlled trials conducted between 2011 and 2013. The authors reported that SLT was non-inferior to ALT in IOP reduction in achieving treatment success. Moreover, the reduction in number of medications was similar between SLT and ALT.⁶ Overall, among OAG patients who ranged from newly diagnosed to those on maximally tolerated medical therapy, SLT resulted in a 6.9%-35.9% IOP reduction.

A major advantage of SLT is its excellent safety profile. As noted previously, SLT targets pigmented cells only and does not cause thermal or coagulative damage like ALT.⁴ However, it should be noted that SLT may cause complications, most typically a transient spike in IOP within 1-5 hours postoperative, and iritis which usually resolves within 5 days post-surgery.⁷ Other rare complications may include corneal haze, hyphema, choroidal effusion, foveal burns and macular edema.

It is also important to highlight that SLT will likely need to be repeated approximately every 2-3 years to maintain the target IOP. However, a key benefit of SLT over ALT is that it can be repeated as many times as required without risk of damage.⁸ The efficacy of SLT as a repeat treatment has also been demonstrated in studies, such as that of Shah et al and Hong and colleagues.^{9,10} Shah and team found that in 70% of cases, repeat SLT reduced IOP by at least 20% at post-treatment year one and this reduction was maintained in 53% of cases by post-treatment year two.⁹ Hong et al identified additional IOP decreases of 5.0 and 2.9 mmHg between first and second SLT treatments, respectively.¹⁰

First-Line, Second-Line and Beyond

SLT helps take care of patients across the entire glaucoma treatment spectrum from treatment-naïve patients to those who have undergone trabeculectomy or tube shunt surgery.¹¹

When SLT was first launched, glaucoma specialists typically reserved SLT for patients on maximally tolerated medical therapy. However, studies by Shlomo Melamed and Ian McIlraith show that SLT is most effective when used as a primary therapy. Because glaucoma specialists initially used SLT as a second-line rather than a first-line treatment, patient outcomes were suboptimal. This led to skepticism among glaucoma specialists about the efficacy of the procedure.^{12,13}

Fortunately, in recent years there has been a shift in opinion as to where SLT belongs in the glaucoma treatment paradigm, thanks in part to a 2012 study by L. Jay Katz et al, Wills Eye Hospital, Philadelphia. In this 1-year, prospective, randomized study, 69 patients (127 eyes) were treated with SLT or a prostaglandin as a primary therapy. In the SLT group (n=29), IOP was reduced from 24.5 mm Hg to 18.2 mm Hg at the final follow up visit. In the prostaglandin group (n=25), IOP was reduced from 24.7 mm Hg preoperatively to 17.2 mm Hg at the final visit. Findings also showed that at the visit, 11% of patients in the SLT group had received additional SLT, compared to 27% of the prostaglandin group who required additional medication. There was no statistically significant difference between the two groups, leading the investigators to conclude that SLT is a safe and effective primary treatment for OAG and ocular hypertension.¹⁴

Based on his experience to date, Dr Teymoorian notes that the growing use of SLT as a primary therapy reflects a larger trend in when and how glaucoma patients are diagnosed.

“It used to be that patients were diagnosed with glaucoma once there was already some damage to the optic nerve. Now we see patients coming in for treatment much earlier,” says Dr Teymoorian. “Average life expectancy has also increased to 75-80 years, so if a patient presents with glaucoma at 40 years of age, they’re facing 35 years of treatment. We can’t just jump straight to penetrating surgery.”

As noted previously, data suggests that when presented with a newly-diagnosed open-angle glaucoma patient, the ideal scenario is to perform SLT as a primary treatment in medication-naïve open-angle glaucoma patients. Studies have shown that if performed prior to use of medication, SLT increases the IOP-lowering effect of pharmacological agents, such as prostaglandins, beta blockers and carbonic anhydrase inhibitors, and also stabilizes diurnal IOP variation.^{15,16} A 2006 study that included 100 eyes (61 patients) also found that SLT was as effective as medication when offered as a first-line treatment. Specifically, the responder rates (20% pressure reduction) were 83% and 84% in the SLT and medication groups, respectively.¹³ Findings from an analysis of 1,393 eyes in database of Lawrence Jindra, MD, Floral Park, New York, show that primary SLT can reduce mean IOP by 31% (from a mean of 18.9 mmHg to 13.0 mmHg) over an average follow-up of 757 days. These findings echo those of the Glaucoma

Laser Trial and Ocular Hypertensive treatment Study, which showed that primary laser trabeculoplasty effectively lowers IOP in treatment-naïve patients, which in turn minimizes long-term vision loss.^{3,17}

Dr Teymoorian notes that there are some patients that particularly benefit from SLT as a primary treatment. These include busy younger patients and older patients who perhaps have problems with movement or memory issues.

“When you’re 40 or 50 years old and you’re busy and you’re on drops, there is a tendency not to use them, even though I tell my patients that if they don’t comply with treatment they could lose their vision. Unfortunately, if patients aren’t compliant with medication they’re pushing themselves towards invasive surgery early in life,” he says. “SLT is also ideal for older patients who are either arthritic or who have dementia and either forget to take their eye drops or have to rely on their caregivers to administer their medicine.”

SLT is also an effective secondary treatment for patients who remain uncontrolled despite multiple medications.

The Jindra database results showed that use of secondary SLT in 1,016 eyes decreased mean IOP by 22% (from mean of 19.8 mmHg to 15.5 mmHg) over a follow-up period of 520 days. In addition, mean medication use fell by 57% from a mean of 2.3 to 1.0 medication types and 67% of all patients referred for SLT while taking anti-glaucoma medications ended up on zero medication after SLT.

“In the middle of the glaucoma spectrum we have patients on medication but for whom IOP is not under control. Rather than adding more medication or jumping to a trabeculectomy or a tube shunt, SLT can and should be considered as an alternative. If a surgeon performs trabeculectomy in a 60 year old healthy patient and it doesn’t go well, the patient is faced with another 15-20 years of poor vision,” says Dr Teymoorian.

Dr Teymoorian adds that SLT is also ideal for patients who have tried medication but can’t tolerate side effects such as stinging, itching and redness. “Patients don’t like the side effects of medication, especially when these symptoms are often visible to and commented on by others. Some patients are also worried about glaucoma medication pigmenting their iris and skin. They want to look at alternative options.”

SLT is also beneficial for patients who have underdone invasive surgery and don’t wish to undergo further surgery or who are no longer candidates for surgery.

In 2016, Zhang et al published findings from a study in patients with post-trabeculectomy advanced primary open-angle glaucoma (POAG). Sixteen patients with POAG (18 eyes), who could not obtain target IOP following medication and surgery, were treated with 360° SLT. Prior to SLT, the patients were administered different types (average, 2.8 ± 0.8) of anti-glaucoma drugs and had an average IOP of 21.3 ± 3.4 mmHg. Following SLT, the average IOP decreased to 16.2 ± 3.0 mmHg and the success rate was 77.7%.¹¹

“SLT is very useful in this setting,” says Dr Teymoorian. “Even if we can get the IOP down just a little it will help to maintain the patient’s vision. In these patients, every point now can matter in the long-term care.”

Integrating SLT into Clinical Practice

One of the main challenges of SLT adoption is the patient’s perception of the procedure. When Dr Teymoorian sees a newly-diagnosed patient, he tells them there are three options: eye drops, laser, or surgery. “They will often say, well how about we don’t do laser or surgery. There is a perception that laser treatment is surgery; patients tend to lump the two together even though their risk profile is very different,” he says. “I then might ask whether they want to use a medication every day, or have SLT and be done with it for 2-3 years. Many patients still shy away from the laser, but that’s changing. I think patients can get tired of the side effects associated with eye drops and the compliance that is needed for them to be effective.”

In order to change the perception of SLT, Dr Teymoorian plays a video in his office designed to show patients what SLT is, and that it’s not surgery as they know it. He also asks his staff to always refer to SLT as a procedure rather than as a surgery to help illustrate the difference.

Patient Selection Considerations

Clinicians have reported that primary SLT works well in all types of OAG patients, especially in those with pigmentary and exfoliative glaucoma. However, patients with uveitic, inflammatory or neovascular glaucoma have been found to be poor candidates for SLT because they have already incurred a large amount of inflammation in their eyes, which negates the inflammatory mechanism that underlies SLT. Dr Teymoorian adds that SLT may not work as well in narrow angle glaucoma as it does in OAG because the trabecular meshwork is more difficult to visualize. However, he adds that this is a more of a technical issue rather than a contraindication per se.

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“There are over 40 types of glaucoma, but only a few that SLT is contraindicated in,” says Dr Teymoorian. “There is a large population of patients that are ideal candidates for SLT; it’s more a question of increasing familiarity and changing the perception of laser treatment. Half of patients will likely need two or more medications in their lives while the other half will only need one. SLT is really the equivalent of one medication so that accounts for 50% of patients.”

An Evolving Treatment Landscape

Going forward, Dr Teymoorian predicts that there will be a shift in how physicians take care of OAG patients. Firstly, there are a number of new medications coming into play. These will be different to current medical therapy both in mode of actions and method of delivery and include a triple-action Rho-Kinase/norepinephrine transporter (ROCK/NET) inhibitor, a quadruple-action medication combining a ROCK/NET inhibitor and a prostaglandin analogue, and punctal plugs and rings eluting glaucoma medication.¹⁸ There is also MIGS, which include ab-interno canaloplasty (ABiC), the iStent and the Trabectome.

“The spectrum that began with eye drops and ended in complicated, high-risk surgery is changing. This is good news for glaucoma surgeons as it means we don’t have to go down the route of invasive surgery until the end, if at all,” says Dr Teymoorian.

Dr Teymoorian also notes that the glaucoma treatment setting will also change, thanks in part to SLT. Typically, since SLT is considered to be surgery, it is reserved for the glaucoma specialist. However, Dr Teymoorian believes there will be a shift

towards general ophthalmologists treating glaucoma with SLT simply because of the growing demand for treatment resulting from an aging population. “There are only so many glaucoma specialists and we will probably end up seeing the worst of the worst cases. The general ophthalmologist is going to have to step up and offer treatment”, he says.

While it is not common that general ophthalmologists perform other forms of glaucoma surgery, SLT is an ideal option. “A general ophthalmologist can easily learn how to do SLT. If a surgeon can do a capsulotomy, then they can do SLT. Actually, SLT is easier because it doesn’t involve any cutting,” says Dr Teymoorian. “All general ophthalmology practices should have an SLT laser.”

Despite the influx of MIGS and new medications, SLT has the potential to become the go-to glaucoma treatment. Perhaps most exciting are the findings from both published studies and surgical experiences which show that SLT is as an effective alternative to medications in patients with newly-diagnosed glaucoma. Therefore, not only can SLT eliminate or at least reduce the need for expensive and inconvenient eye drops, it can help to preserve vision and delay or even prevent complicated, invasive surgical interventions. SLT is also safe and effective, can be administered by general ophthalmologists, is repeatable and affordable, and may be used at any stage of the disease spectrum, making it a truly comprehensive glaucoma treatment. Mostly importantly, SLT can help maximize patient quality-of-life.

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