17 Selective laser trabeculoplasty

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THE INSTRUMENT/DEVICE

- Proparacaine hydrochloride 0.5% (Alcaine, Alcon, Fort Worth, Texas)
- Apraclonidine 0.5% (Iopidine 0.5%, Alcon) or brimonidine 0.2 or 0.15% (Alphagan P, Allergan, Irvine, California)
- Selective laser trabeculoplasty (SLT) laser (frequency-doubled Q-switched neodymium [Nd]:yttrium–aluminum–garnet [YAG] laser, Lumenis, Santa Clara, California)
- Goldmann three-mirror goniolens or Latina SLT lens (Ocular Instruments, Bellevue, Washington)
- Methylcellulose 1% (Goniosol, Ciba Vision Ophthalmics, Atlanta, Georgia)
- Ketorolac tromethamine 0.4% (Acular, Allergan)
- Prednisolone acetate 1% (Pred Forte 1%, Allergan)

INDICATIONS AND CONTRAINDICATIONS

Selective laser trabeculoplasty was approved by the US Food and Drug Administration in March 2001 and uses a frequency-doubled Q-switched Nd:YAG laser providing 3 ns of pulse energy with a large 400 µm laser beam diameter aimed at the trabecular meshwork (TM) (Fig. 17.1). This laser lowers intraocular pressure (IOP) by selectively targeting pigmented TM cells while leaving cellular membranes and neighboring non-pigmented cells intact.[1,2] SLT is based on the principle of selective photothermolysis, which relies on selective absorption of a short laser pulse to generate and spatially confine heat to pigmented targets.[3] Histopathologic evaluation of the TM in eyes post SLT reveals no evidence of coagulative damage or disruption of the corneoscleral or uveal TM beam structure, unlike in argon laser trabeculoplasty (ALT), where coagulative damage is evident (Fig. 17.2).[4]

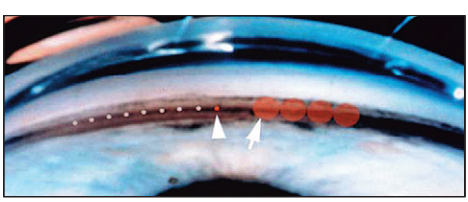

FIGURE 17.1 Argon laser trabeculoplasty (ALT) spot size of 50 µm (left arrow) versus selective laser trabeculoplasty (SLT) spot size of 400 µm (right arrow). Although both ALT and SLT spots are centered over the border of the anterior non-pigmented and posterior pigmented trabecular meshwork, SLT spots are contiguous and ALT spots are not. (Courtesy of C. Park, M.D.)

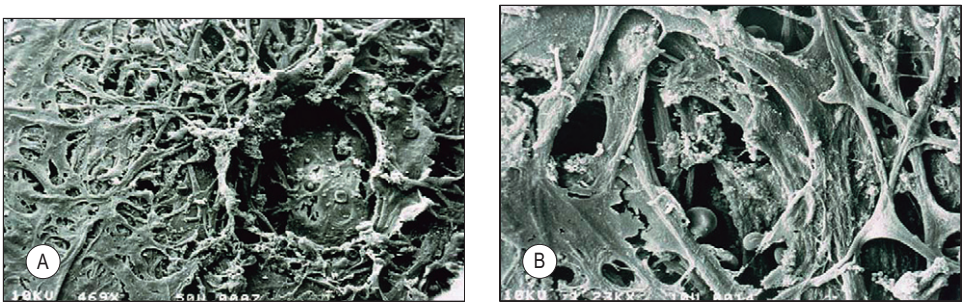

FIGURE 17.2 Scanning electron microscopy (SEM) after argon laser trabeculoplasty (**A**) reveals crater formation and disruption of the ropelike components of the trabecular meshwork (TM). SEM after selective laser trabeculoplasty (**B**) shows intact TM beams. (From Kramer and Noecker 2001,[4] with permission.)

Selective laser trabeculoplasty is an effective and safe alternative to ALT in the treatment of open angle glaucoma. Because of its low risk of adverse effects, SLT may be a good alternative for long-term medical therapy. Several authors have demonstrated that SLT is effective for primary treatment for newly diagnosed open angle glaucoma, as an adjunct to medication, as an alternative for patients who are poorly compliant or have problems obtaining or are intolerant to glaucoma medications, or as an end-stage treatment to avoid surgery in patients who are already on multiple medications.[5,6]

Although SLT indications are similar to those of ALT, it may also be effective in patients with failed ALT. Because it causes no scarring of the TM, SLT is also a potentially repeatable procedure. SLT has been shown to work well with pseudoexfoliative glaucoma, pigmentary glaucoma, and juvenile open angle glaucoma.[7] SLT should not be used in patients with narrow angles, congenital glaucoma, or neovascular glaucoma, and should be used cautiously with inflammatory glaucoma.[7]

SURGICAL TECHNIQUE

Preoperative preparation

Because transient post-SLT IOP spikes may occur in some patients, apraclonidine 0.5% (Iopidine) or brimonidine 0.15 or 0.2% may be given 1 hour before the procedure. A drop of proparacaine hydrochloride 0.5% (Alcaine) is given prior to the laser procedure.

Procedure

With the patient seated at the SLT laser slit-lamp system, a Goldmann three-mirror goniolens or Latina SLT lens is coupled with methylcellulose 1%. The low-power helium:neon laser aiming beam is focused on the pigmented TM, and its spot size (400 µm) should encompass the entire anteroposterior height of the TM. Because of its broad spot size on

the TM, SLT is a simple laser technique for an ophthalmologist to master. Treatment of Sampaolesi's line should be avoided, because this is made up of non-TM cells but pigmented corneal endothelial cells, and treatment here could cause a focal corneal endotheliitis. Standard therapy is to deliver 50–100 adjacent non-overlapping laser spots over 180–360° of TM (Fig. 17.1). Power is adjustable from 0.2 to 1.7 mJ and initially set at 0.8 mJ (Table 17.1). More pigmented TMs (as in pigmentary, pseudoexfoliation, traumatic glaucoma, and some diabetics) require lower power. Unlike in ALT, blanching or large vaporization bubbles within the TM are not seen as an end point in SLT; however, tiny 'champagne' bubble formation is used as an end point for setting SLT pulse energy. Small champagne bubbles should be seen at least 50% of the time; however, they might not be seen in lightly pigmented TMs. If there are no champagne bubbles observed, the power may be increased to 1.0–1.2 mJ/pulse (Table 17.1).

Postoperative care

Pretreatment glaucoma medications may be resumed post SLT.

A wide variety of topical antiinflammatory medications have been used for posttreatment prophylaxis, some of which are noted in Table 17.1. However, it is not necessary to use any topical antiinflammatory agents postoperatively. It is felt that topical antiinflammatory agents may blunt some of the biological effects of SLT. The biological effects in SLT may be more important than the mechanical effects and include some immediate responses involving the release of chemotactic and vasoactive agents that are involved in the release of gelatinases, metalloproteinases, macrophage recruitment, and in other biological activities that result in improved aqueous outflow.[8]

Some patients may have mild eye discomfort post laser, which responds well to non-steroidal antiinflammatory drops bid for 2–3 days.

OUTCOME

There are two clinical trials[2,9] that led to SLT marketing approval and that demonstrated IOP reduction of 20–35% from baseline. SLT had greater success and efficacy in patients treated as primary therapy with IOP reductions of 30–35% with 95% response rates compared with IOP reductions of 20–25% with 70–85% response rates when used as an adjunctive therapy to medication. Follow-up of patients treated with SLT as a primary intervention indicate that its efficacy can be maintained long term with a continued success rate of about 75% after 2.5 years.[5] In a prospective randomized clinical trial comparing IOP reduction of ALT with SLT, Damji found that SLT is equivalent to ALT in IOP lowering during the first 6 months after treatment.[9]

TABLE 17.1 Treatment parameters for selective laser trabeculoplasty for the different types of glaucoma

Glaucoma type	Pretreatment drops	Power (mJ)	End point for power adjustment	No. of spots	Posttreatment drops	Recommended first follow-up visit
Primary open angle glaucoma/ocular hypertension/normal tension glaucoma	1 gtt of proparacaine hydrochloride 0.5% (e.g. Alcaine), 1 gtt of apraclonidine 0.5% (Iopidine) or brimonidine 0.15 or 0.2% (e.g. Alphagan P)	0.8	Champagne bubbles seen 50% of the time (if none, increase to 1.0–1.2 mJ)	50–100 spots on 180° of trabecular meshwork	Ketorolac tromethamine 0.4% (e.g. Acular) or prednisolone acetate 1% (e.g. Pred Forte) tid for 3 days	7–10 days
Pigmentary		0.4–0.6	Champagne bubbles seen 50% of the time (if none, increase to 0.8–1.0 mJ)	< 50 spots on < 180° of trabecular meshwork	Ketorolac tromethamine 0.4% (e.g. Acular) or prednisolone acetate 1% (e.g. Pred Forte) t.i.d. for 4 days	1–3 days
Pseudoexfoliation glaucoma		0.5–0.7		50 spots on < 180° of trabecular meshwork		3–7 days

TABLE 17.2 Summary of reports on the intraocular pressure lowering effects of selective laser trabeculoplasty[a]

Reference	Study population	Baseline IOP (mmHg)	Average follow-up period	Response rate (%)	IOP drop
Kaulen (personal communication)	460 eyes of 328 patients	–	2 years	–	23%
Latina et al (1998)[2]	45 POAG MTMT	25.3	26 weeks	70	5.8 mmHg (23.5%)
	56 POAG after ALT	25.6			6.0 mmHg (24.2%)
Lanzetta et al (1999)[10]	8 POAG	26.6	6 weeks	–	10.6 mmHg (39.9%)
Kano et al (1999)[11]	49 POAG	22.4	6 months	68.7	4.4 mmHg
	19 POAG after ALT				
Kahiya et al (2000)[12]	18 POAG	22.8	6 months	–	8.8 mmHg
Howes et al (2001)[13]	155 POAG	–	6 months	95	26.4–30.6%
	14 OHTN				30.2%
Weimar and Kaulen (personal communication)	166 POAG	–	20 months	81	22.8%
	60 POAG after ALT			59	17.7%
	18 POAG after ALT			47	9.9%
	25 PXFG			84	35.6%
	48 OHTN			90	–
Kim et al (2000)[14]	13 eyes	24.4	12 months	–	4.9 mmHg (20%)
Gracner (2001)[15]	50 POAG	22.5	6 months	88–92	5.1 mmHg (22.5%)
Latina et al (2001)[16]	101 POAG	–	6 months	75.6	4.4 mmHg (17.2%)
	45 MTMT			66.1	5.2 mmHg (20.3%)
	56 failed ALT			–	3.8 mmHg (14.7%)
Gracner (2002)[17]	10 PXFG	23.6	12 months	64	31.4%
	10 POAG	22.8	13.5 months	78	35.1%

continued

TABLE 17.2 (*Cont'd*)

Reference	Study population	Baseline IOP (mmHg)	Average follow-up period	Response rate (%)	IOP drop
Nagar et al (2002)[18]	207 POAG and OHTN	–	26 months	–	POAG: 25.6% OHTN: 33.0% POAG: 28.5% OHTN: 29.5%
Melamed et al (2003)[5]	45 POAG primary treatment	25.5	6–18 months	–	7.7 mmHg (30%)
Cvenkel (2004)[19]	44 eyes (uncontrolled POAG) of 31 patients	25.6	12 months	3 months: 66 6 months: 78 12 months: 62	7.1 mmHg (27.6%)
Lai et al (2004)[20]	58 eyes with POAG or OHTN	26.8	5 years	–	8.7 mmHg (32%)
Rozsival et al (2004)[21]	258 eyes	23.9	13 months	–	4.5 mmHg (18.6%)
Anschutz (personal communication)	398 patients	22.3	12–24 months	82	12 months: 4.4 mmHg (19.8%) 24 months: 4.1 mmHg (18.4%)
Garza-Saide et al (personal communication)	245 patients	27.6	32 weeks	–	9.4 mmHg (33%)
Damji et al (1999)[9]	18 POAG	22.8	6 months	–	4.8 mmHg (21.9%)

ALT, argon laser trabeculoplasty; IOP, intraocular pressure; MTMT, maximally tolerated medical treatment; OHTN, ocular hypertension; POAG, open angle glaucoma; PXFG, pseudoexfoliation glaucoma; SLT, selective laser trabeculoplasty.
[a]A 'response' was achieved if intraocular pressure was lowered ≥ 3 mmHg.

Table 17.2 is a summary of available reports of the pressure-lowering effect of SLT.

Selective laser trabeculoplasty has a low complication rate, because it delivers only 0.01% of ALT's energy. Kaulen et al (personal communication) observed a post-SLT complication rate of 4.5%, which was much lower than the complication rate seen post ALT, which may reach up to 34%. Common post-SLT complications that are easily treated are significant anterior chamber inflammation and IOP elevations.[22] Melamed et al found that both the visual acuity and visual fields do not change, and gonioscopy did not detect any scarring or peripheral anterior synechiae formation.[5]

A multicenter, prospective, randomized, controlled clinical study called the SLT/MED Study is now underway. SLT/MED was designed to investigate SLT as initial treatment for open angle glaucoma compared with topical medical therapy. This study, aside from confirming SLT's status as a primary treatment choice, will investigate other aspects of glaucoma treatment using this laser, such as producing fewer drug-related side effects, minimizing glaucoma treatment cost, addressing compliance, and assessing general quality of life issues.

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