Evaluating selective laser trabeculoplasty versus argon laser trabeculoplasty in pseudoexfoliation glaucoma patients

Jin Soo A. Song, BScH,[*,†] Jayme Vianna, MD,[†] Lesya Shuba, PhD, MD, FRCSC,[†] Paul Rafuse, PhD, MD, FRCSC,[†] Marcelo Nicolela, MD, FRCSC[†]

ABSTRACT ●

Objective: Laser trabeculoplasty effectively reduces intraocular pressure (IOP) in primary open angle glaucoma, with argon laser trabeculoplasty (ALT) and selective laser trabeculoplasty (SLT) showing equivalent outcomes. However, it is unclear which laser modality is more effective in pseudoexfoliation (PXE) glaucoma. This study aims to compare the effectiveness of ALT and SLT in PXE glaucoma.

Design: Retrospective cohort study.

Methods: A chart review evaluating patients diagnosed with PXE glaucoma and treated with laser trabeculoplasty from 2005-2015. Patients with previous glaucoma surgery, other forms of secondary glaucoma, ocular surgery within six months of initial trabeculoplasty or lacking preoperative IOP measurements were excluded. Post-laser measurements were recorded until 24 months after initial intervention. Follow-up data was censored if the patient underwent a subsequent trabeculoplasty different from initial laser treatment.

Results: We included 84 patients in the ALT group and 123 in the SLT group. The mean (SD) baseline IOP values were 22.7 (±5.6) and 21.6 (±4.8) respectively ($p = 0.11$), while number of medications were 2.0 (±1.0) and 1.8 (±1.3) for ALT and SLT groups respectively ($p = 0.36$). The mean IOP reduction for the ALT group at 6, 12 and 24 months were 5.2 (±6.1), 5.4 (±6.9), and 4.9 (±7.7) respectively. The corresponding values for the SLT group were 3.4 (±5.2), 3.8 (±4.6), and 4.6 (±6.5). Comparison of both lasers at each time point revealed no significant differences ($p > 0.05$) in IOP reduction or reduction of glaucoma medication.

Conclusions: Our study showed equivalent efficacy between ALT and SLT in patients with PXE glaucoma.

Pseudoexfoliation glaucoma (PEXG) was first noted in 1917 as a progressive age-related ocular disorder resulting in accumulation of proteinaceous fibrillar material within the extracellular matrix of the eye.[1,2] These aggregates are hypothesized to result from oxidative stress on multiple anterior segment cell types, resulting in production and dissemination of glycoconjugate encased proteins.[2,3] The cumulative deposition of these protein deposits, known as pseudoexfoliative material, obstructs outflow of aqueous humor[1,2,4–6] and consequently increases intraocular pressure (IOP). PEXG has been identified as the most common cause of secondary open-angle glaucoma, accounting for 25% of all glaucoma cases worldwide.[1] Patients with PEXG tend to have a more aggressive clinical course when compared with patients with primary open-angle glaucoma (POAG) because of faster disease progression, higher IOP at diagnosis, and increased likelihood of surgical intervention.[2,7]

Laser trabeculoplasty is a frequently performed procedure in the management of glaucoma, often used as an intermediary step between topical eye drops and surgery.[1,2,7] A growing body of literature has shown that laser treatment is particularly effective in patients with PEXG, possibly related to the higher uptake of laser energy from trabecular hyperpigmentation.[7]

The 2 most common forms of laser trabeculoplasty in use are argon laser trabeculoplasty (ALT), first introduced as by Wise and Witter in 1979, and selective laser trabeculoplasty (SLT), introduced as an alternative approach in 1995.[1,6] ALT is thought to induce focal scarring in the trabecular meshwork through high-energy thermal beams, opening the conduit through intervening perforations.[1,5,6] SLT differs by specific cell targeting and using lower energy to create similar outcomes without visible scarring.[1,4,5] The current literature shows equivalent IOP reduction with either treatment modality in patients with POAG, yet outcomes in those with PEXG are still unclear.[1,4,5,8–10] Our study aims to compare outcomes between ALT- and SLT-treated patients with PEXG.

Materials and Methods

We conducted a chart review from the practices of the 3 ophthalmologists (P.R., L.S., M.N.) who performed laser trabeculoplasty within the Department of Ophthalmology & Visual Sciences at the Queen Elizabeth II Health Sciences Centre. Approval for data collection was secured by the Capital Health Ethics Research Board before commencing the study. Patients who had a clinical

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Table 1—Patient demographics

Parameter	ALT	SLT	*p*
n	84	123	
Lens status	83 pseudophakic and 1 phakic	122 pseudophakic and 1 phakic	1.00
Age, mean ± SD (range), y	71.62 ± 9.03 (55–95)	70.66 ± 9.06 (42–90)	0.45
Sex	28 M and 56 F	50 M and 73 F	0.36
Baseline IOP, mean ± SD (range), mm Hg	22.71 ± 5.56 (14.33–40)	21.56 ± 4.76 (13.33–37.33)	0.11
Baseline number of glaucoma medication, mean ± SD (range)	2 ± 0.99 (0–5)	1.83 ± 1.29 (0–6)	0.36

ALT, argon laser trabeculoplasty; SLT, selective laser trabeculoplasty; IOP, intraocular pressure.
Unpaired *t* test was conducted.

diagnosis of PEXG and billing codes between 2005 and 2015, representing treatment with laser trabeculoplasty, were assessed for study eligibility. Before diagnosis, gonioscopy was used to confirm open-angle glaucoma. Patients with any prior laser trabeculoplasty, glaucoma surgery, or ocular surgery within 6 months of laser treatment were excluded. Furthermore, patients with POAG or any other form of secondary glaucoma were ineligible.

For both procedures (ALT and SLT), patients received 1 drop of pilocarpine 1% and 1 drop of apraclonidine 0.5% approximately 30 minutes before the laser treatment and 1 drop of procaine hydrochloride 0.5% immediately before treatment. The initial laser settings for the ALT treatment were laser power of 750 mW, spot size of 50 μm in diameter, and duration of 0.1 second. The power was adjusted up or down depending on trabecular meshwork pigmentation and tissue response during the procedure. The initial laser settings for the SLT treatment were laser power of 0.6 mJ, spot size of 400 μm in diameter, and duration of 3 ns pulse. Similar to ALT, the power for SLT was adjusted up and down depending on trabecular meshwork pigmentation and tissue response during the procedure. For both treatment modalities, the treatment encompassed 180 degrees of the angle, initially inferiorly and then superiorly if a second treatment was necessary. In cases requiring more than 2 treatment sessions, the third session was typically done inferiorly again, followed by superiorly. Postoperatively, patients receiving ALT treatment were prescribed prednisone acetate 1% 4 times per day for 4 days; patients receiving SLT treatment were prescribed nonsteroidal anti-inflammatory drops for 3 days, although the type of nonsteroidal anti-inflammatory topical medication used varied over time and among the 3 physicians.

Patients were assigned to the ALT or the SLT treatment groups according to the type of laser used in their first trabeculoplasty treatment. If patients had both eyes treated with trabeculoplasty, both eyes were included if each eye received a different laser modality. If both eyes received the same type of laser, then only the eye treated first was included.

Baseline IOP was calculated by averaging up to the 3 most recent IOP measurements before the procedure date. For each patient, post-treatment IOP values, number of glaucoma medications, and any major complications were recorded until they underwent another trabeculoplasty procedure different from the initial laser, underwent glaucoma surgery, or were lost to follow-up. Patient demographics, specifically age and sex, were also recorded.

IOP reduction from baseline was quantified in absolute and percentage values. The change in number of medications from baseline was also determined. We collected IOP and medication data at 6, 12, and 24 months postoperatively, allowing a 2-month date range for flexibility.

Data analysis was performed with SPSS version 22 software. Differences in means between groups were assessed using the unpaired Student *t* test. A Kaplan–Meier survival analysis was conducted with the following failure criteria: (*i*) inability to decrease IOP by 15% or greater for 2 consecutive follow-up visits relative to baseline IOP, (*ii*) addition of 2 or more medications at any follow-up visit relative to baseline number, (*iii*) any incidence of catastrophic complication from the laser trabeculoplasty, and (*iv*) any incidence of surgical intervention for glaucoma. Patients who underwent subsequent laser trabeculoplasty of the opposite treatment arm were censored, whereas repeat laser procedures of the same type were allowed.

Results

A total of 207 eyes from 204 patients from our centre were eligible for the study. These patients were further separated into 84 eyes treated with ALT and 123 treated with SLT. The lens status of pseudophakic:phakic was 83:1 for ALT and 122:1 for SLT ($p = 1.00$). In terms of patient demographics, the mean age was 71.62 ± 9.03

Table 2—Average absolute reduction in IOP

	ALT		SLT		
Visit, mo	n	Absolute IOP Reduction, mean ± SD (range), mm Hg	n	Absolute IOP Reduction, mean ± SD (range), mm Hg	*p*
6	61	−5.16 ± 6.06 (−25 to 6)	87	−3.35 ± 5.2 (−23.33 to 12)	0.06
12	54	−5.35 ± 6.88 (−24.5 to 13)	84	−3.84 ± 4.59 (−23.33 to 6.33)	0.16
24	49	−4.93 ± 7.69 (−32.5 to 12.5)	60	−4.55 ± 6.52 (−21 to 12.67)	0.79

IOP, intraocular pressure; ALT, argon laser trabeculoplasty; SLT, selective laser trabeculoplasty.
Unpaired *t* test was conducted.