Review Article

Selective laser trabeculoplasty: a review of repeatability

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Abstract: The efficacy of selective laser trabeculoplasty (SLT) to treat open-angle glaucoma (OAG) and ocular hypertension (OHT) has been increasingly substantiated lately. Repeated SLT is usually needed to control intraocular pressure (IOP), be it as primary or adjunctive therapy. We review the studies available, in terms of SLT repeatability; and conclude comparable efficacy, with success rate, duration and complications similar to those in initial SLT.

Keywords: Selective laser trabeculoplasty (SLT); repeatability; repeat; glaucoma

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Introduction

Selective laser trabeculoplasty (SLT) was developed in 1997 by Latina *et al.* (1), to treat open-angle glaucoma (OAG), and was then approved by FDA in 2001; its clinical efficacy to lower intraocular pressure (IOP) in OAG has been universally adopted.

The exact mechanism is yet to be fully understood; yet some evidence suggests that SLT-induced inflammation increases permeability of the Schlemm's canal endothelial cells (2-4). The effect, after successful SLT, diminishes with time, and patients often require additional intervention, to maintain target IOP. Also, a significant number of patients do not respond well to initial SLT treatment. Thus, SLT repeatability has assumed tremendous importance in recent years.

SLT has been adopted by clinicians, even as a first-line treatment, for its enduring IOP-lowering efficacy (5-7). If repeated SLT can ensure consistent optimal effect, several patients with OAG or ocular hypertension (OHT) may opt for conventional eye drops as a secondary treatment choice, which, in turn, will circumvent side effects, and patient compliance issues, while reducing health care costs.

Recent articles only briefly reference SLT repeatability (8-10), therefore, in this study, we systemically review previously conducted analyses on the same; the aim being to summarize clinical evidence, so as to support and improve our daily practice.

Repeatability

Currently available studies pertaining to repeat SLT are summarized in *Table 1*.

Hong *et al.* (11) published the first article regarding SLT repeatability in 2009, which reviewed 44 eyes of 35 patients, with successful initial 360° SLT1, and a 360° SLT2 was performed at least 6 months later, due to lost of efficacy. Diagnoses included primary open-angle glaucoma (POAG), pseudoexfoliative glaucoma (PXG) and pigmentary glaucoma (PG). Success was defined as ≥20% IOP reduction, as compared to pretreatment baseline IOP. The study revealed, both SLT1 and SLT2 presented no significant variance in success rate and IOP-lowering effect, with the exception of IOP lowering further at 1–3 months after SLT1, than with SLT2. There was no significant efficacy variance if SLT2 was given 6 months after initial SLT1.

Avery *et al.* (12) studied 42 eyes of 42 patients with only

Table 1 Summary of conducted studies regarding SLT repeatability.

Paper	Year	Diagnosis	Number of eyes (n)	Number of patients (n)	Conclusion
Hong *et al.* (11)	2009	POAG, PXG and PG	44	35	The repeat 360° SLT performed 6 months after the successful initial 360 SLT may be safe and effective
Avery *et al.* (12)	2013	POAG	42	42	Similar efficacy was found in primary SLT and repeat SLT in treatment of POAG. Repeat SLT produces a longer effective duration
Khouri *et al.* (13)	2014	POAG, PXG and PG	51	34	Equal proportion of eyes responds successfully to repeat SLT regardless of the initial SLT effect was successful or modest
Ayala *et al.* (14)	2014	POAG and PXG	80	80	Repeat SLT on the same trabecular meshwork area has same effect as on two different areas
Khouri *et al.* (15)	2014	POAG, PXG and PG	45	25	Repeat SLT is effective in controlling IOP up to 2 years
Polat *et al.* (16)	2016	POAG, PXG and PG	38	38	IOP in open-angle glaucoma can be controlled with repeat SLT which achieves comparable result as successful initial SLT
Francis *et al.* (17)	2016	POAG, PXG, PG, OHT and JOAG	137	137	Both initial SLT and repeat SLT with 360-degree treatment lowers IOP similarly
Durr *et al.* (18)	2016	POAG, PXG and NTG	38	38	The second SLT resulted in similar IOP lowering effect as previous 360° SLT with possibly more sustained response

SLT, selective laser trabeculoplasty; POAG, primary open angle glaucoma; PXG, pseudoexfoliative glaucoma; PG, pigmentary glaucoma; OHT, ocular hypertension; JOAG, juvenile open angle glaucoma; NTG, normal tension glaucoma; IOP, intraocular pressure.

POAG, in 2013. SLT was performed with 40–50 shots over 360°. Success of treatment was defined by a minimum 20% reduction in pretreatment IOP, or a post-treatment IOP at or below target IOP. The results found no significant statistical difference between SLT1 or SLT2, in terms of mean IOP reduction, success rate, or duration of success, yet the treatment success duration after repeat SLT was longer than with primary SLT. During the study, 9 eyes were treated with a third SLT that also showed seemingly comparable success (56%) rate, and mean IOP reduction at 4 weeks (18.9%) and at 4 months (17.7%). SLT3 results were however not included in this analysis. The authors disagree with the idea that repeat SLT has lesser chance of efficacy when performed within a short time, after failed initial SLT.

Khouri *et al.* (13) proved Avery's perspective that a similar proportion of eyes responded successfully to repeat SLT, regardless of a successful or modest response to initial SLT.

Ayala *et al.* (14) evaluated the IOP-lowering effect of repeat SLT on either the same 180° as initial SLT, or on the opposite 180°, and the results were not significantly different. This study, based on a prospective randomized clinical trial, reviewed a group of 80 eyes from 80 patients, with diagnoses including POAG and PXG.

Khouri *et al.* (15) in 2014 published the first peer reviewed study on the long term efficacy of repeat SLT, on a cohort of 25 subjects. Forty-five eyes were treated with Initial SLT and repeat SLT 360°, with mean energy levels of 0.94±0.05 and 1.08±0.23 mJ, and a mean total number of 111±8 and 104±7 spots respectively. Repeat SLT efficacy, realized on subjects with POAG, PXG or PG, could last up to 24 months, with variations in IOP similar to initial treatment, except at 4, 8 and 12 months, wherein initial SLT caused significantly greater reduction of IOP. At 24 months, 29% and 39% of eyes retained IOP reduction >20% and ≥15% respectively.

Polat *et al.* (16) conducted a similar study that was published in 2016. Thirty-eight eyes of 38 patients with POAG, PXG or PG had initial 360° SLT1, followed by repeat 360° SLT2, when SLT1 efficacy subsided. Comparable absolute IOP control levels were achieved by both SLT1 and SLT2; moreover, repeat SLT provided longer median efficacy duration.

Francis *et al.* (17) published their clinical study in 2016, which retrospectively reviewed the success of repeat SLT 360° on a considerably larger cohort of 137 subjects. The

authors established similar results that proved SLT was successful in both initial and repeat treatment of OAG.

Durr *et al.* (18) in 2016 reported similar IOP-lowering effect of 360° SLT, between initial and repeat SLT, based on a retrospective chart review study of 38 independent eyes. Diagnoses of POAG, normal tension glaucoma (NTG) and PXG were included in the study. Repeat SLT exhibited better-sustained responses.

Discussion

The OAG treatment algorithm has been updated and altered in the recent years. To achieve good control of OAG, whilst avoiding polypharmacy, and difficult or non-compliance, new surgical techniques that include argon laser trabeculoplasty (ALT), SLT and minimally invasive glaucoma surgery have been critically reviewed.

SLT has lately replaced ALT in its clinical role, with respect to potential repeatability advantages. The 532 nm, frequency-doubled, Q-switched neodymium-doped yttrium aluminium garnet (Nd: YAG) laser targets the pigment cells in trabecular meshwork, without damaging adjacent cells and tissues (3); this is superior to ALT, which involves collateral thermal damage that prevents repeat success, owing to subsequent trabecular meshwork scarring (3). Moreover, repeat ALT can also lead to peripheral anterior synechiae.

SLT has been widely employed, and even suggested as first line treatment for OAG and OHT, since 360° SLT and Latanoprost efficacy is comparable, over a 12 month period, and the diurnal variation or fluctuation can also be significantly reduced (19-21). The newly published study on *Lancet* from UK supports this adoption in clinical practice. The authors conclude SLT should be offered as a first-line treatment for OAG and OHT, based on their three-year study (22).

The goal of this review is to summarize the clinical evidence of repeat SLT efficacy. The aforementioned studies have proven corresponding efficacy of repeat SLT on 360°, with success being defined as ≥20% IOP reduction mostly, which, in practice, should be objectively defined, since many other factors justify target IOP. Clinicians could repeat SLT alongside other adjunctive treatments, in order to achieve greater IOP reduction; or perform repeat SLT with 180° or less, to achieve sufficient target IOP reduction. The initial SLT energy setting can also be adjusted, based on the objective pigment level in the trabecular meshwork. However, the recommended energy setting to be achieved is 0.1 mJ less than threshold levels that cause bubble formation (23,24). Several clinicians choose to perform SLT on 180°, either superiorly/inferiorly or nasally/temporally and tend to recommend using less energy, but increasing application spots, to avoid inflammation and scarring. The optimal setting for SLT is still uncertain, nevertheless, the repeat SLT efficacy on 360°, should also apply on 180°, or even 90°; although treatment augmentation may still be necessary to achieve therapeutic threshold.

With regard to post-treatment complications, a comparable rate was observed in both repeat SLT and initial SLT. Most reported side effects, including discomfort, redness and IOP elevation, were mild and transient. As for the management of patient, there was no significant difference between repeat SLT and initial SLT. Of note, the changes of IOP should be monitored approximately one hour after performed repeat SLT to rule out a temporary IOP spike.

In spite of the fact that SLT repeatability has been addressed via aforementioned studies, the matter remains controversial, and requires further corroborations. Moreover, maximal SLT repeatability, and its impact on filtration surgery or other treatment methods, is yet to be resolved.

If primary SLT is unsuccessful, or its effects subside, repeat SLT, with comparable efficacy and low complication rates, should be encouraged.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/aes.2019.05.01). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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