Selective Laser Trabeculoplasty versus Topical Anti-Glaucoma Medications in the Treatment of Patients with Primary Open-Angle Glaucoma

Osama Yousef Amin Hassan[1], Abdallah Mohamed El-Amin[2], Tageldin Mohamed Othman[3]

[1]Glaucoma Unit, Department of Ophthalmology, Aswan Ophthalmology Hospital, Egypt

[2]Professor of Ophthalmology, Faculty of Medicine, Al-Azhar University, Egypt

[3]Assistant Professor of Ophthalmology, Faculty of Medicine, Aswan University, Egypt

DOI: 10.47750/pnr.2023.14.03.045

Abstract

Purpose: This study aims to report and compare the percent of eyes with positive responses in the group treated by SLT (IOP falls in the normal range with a cessation or decrease in the number of anti-glaucoma drugs).

Patients and Methods: In the trial, 86 eyes from 51 patients with OAG were enrolled; the recruited sample was divided evenly between the case and control study arms, each of which contained 43 eyes (a treatment group and a control group), as follows: Group I (intervention group): 43 Patients who received SLT as primary or adjunctive therapy, included patients with newly diagnosed POAG, patients who want to decrease medical glaucoma treatment, and patients diagnosed with POAG currently on medical treatment, either intolerant of medical treatment or not well controlled to the target level. Group II (control group): 43 Patients had running on anti-glaucoma treatment. In this study, SLT was performed in the intervention group (group I), and the results were compared to the control group (group II).

Results: SLT significantly reduced the amount of anti-glaucoma medication required while maintaining adequate control, (full replacement) in 23 eyes (53.5%). Partial replacement (reduction in drugs) was achieved in all other cases. The mean number of glaucoma molecules after SLT decreased from 1.79 ± 1.30 after 1 year to 0.63 ± 0.79 with a statistically significant difference all over the follow-up time ($p < 0.001$). According to our findings, SLT is a better method for replacing or reducing the number of glaucoma medications without serious complications occurring for the duration of the study.

Conclusion: SLT is effective as primary or adjunctive therapy for the replacement treatment of POAG.

Keywords: Glaucoma, POAG, medications, IOP, SLT.

INTRODUCTION

The word "glaucoma" refers to a set of ocular conditions with multifactorial aetiologies that are all characterised by a possibly progressive, clinically distinctive intraocular pressure-associated optic neuropathy1. It is regarded as the leading contributor to permanent blindness worldwide2, and OAG accounts for the majority of cases3. More than 110 million people are anticipated to be affected by glaucoma by 2040, with the majority of sufferers (three-quarters) residing in developing nations4.

Currently, glaucomatous optic neuropathy cannot be treated with any proven effective method5. The primary goal of therapy, however, is to lower IOP to the "target IOP range," which is the IOP level at which more optic nerve and visual field damage is not anticipated to happen6. The IOP can be lowered with medicinal, laser, or surgical intervention5.

Because they are less intrusive than alternative treatment choices, the majority of patients frequently favour glaucoma medications7. Consequently, glaucoma medicines have served as the cornerstone of OAG treatment for a very long time7. Prostaglandin analogues (PGAs), beta-blockers, alpha-agonists, carbonic anhydrase inhibitors, and miotics are only a few of the glaucoma drugs that have been commercially accessible during the past 20 years. The use of medicines as a first-line glaucoma therapy comes with a number of disadvantages8.

They frequently need lifetime medication9, which makes ongoing usage difficult and pricey, especially in underdeveloped nations4. Even while the medication lowers IOP, it also has a number of systemic and ocular side effects10. When patients are non-compliant8, the treatment's efficacy may be compromised. Elderly individuals sometimes have difficulty administering topical treatments because they require help or miss the eye and waste valuable medication11.

Additionally, they have poor patient adherence, may need several hospital visits for monitoring and medication modification,

and are a risk factor for eventual surgical failure12. Almost half of all glaucoma treatment failures are attributable to poor medication compliance, which is a global phenomenon10. However, some patients still need laser or incisional surgical intervention13. In fact, many patients are effectively treated with medicinal treatment in the form of eye drops to decrease IOP. SLT might be utilised as a substitute therapy to lessen these troubling challenges14. A well-known addition to medicinal and surgical treatment for primary open-angle glaucoma (POAG) is SLT 15.

Selective laser trabeculoplasty (SLT), a novel and successful technique, was initially introduced by Latina and Park in 1995. The neodymium-doped yttrium aluminium garnet (Nd: YAG) laser used in SLT is 532 nm, Q-switched, and frequency-doubled (3 ns). Without thermally or collaterally harming the non-pigmented cells or structures of the TM, the SLT was created to specifically target pigmented trabecular meshwork (TM) cells16.

SLT and eye drops were compared as first-line therapies for OHT and OAG in the light (RCT). Less glaucoma operations and extremely low rates of adverse effects were the results of SLT, which was more cost-effective and within target, IOP at a larger percentage of visits than eye drops at 36 months. SLT was shown to be less expensive than eye drops as the initial therapy12. Patients treated with drugs initially were more likely to suffer from fast visual field degeneration, according to follow-up studies from the light trial17.

As a result, SLT is currently advised as the first-line therapy for OAG and OHT by the European Glaucoma Society, the American Academy of Ophthalmology, and the National Institute for Health and Care Excellence in the UK18.

In the current study, we assess the effects of SLT and the decrease in glaucoma medications in Upper Egyptian individuals with primary open-angle glaucoma (POAG).

PATIENTS AND METHODS

This study received ethical committee approval. After a thorough process of informed consent, all patients agreed to take part in the study. Letting the patient know that the procedure's goal is to either cease or reduce anti-glaucoma medication. All patients gave their agreement to participate after being fully informed about the experiment.

Fifty-one patients (86 eyes) were enrolled in this prospective study over the past two years.

The study includes participants. Patient over the age of 18. Participants in this study had to have a main OAG diagnosis that had been established. They were not taking any prescriptions when they were found. They had established that the glaucoma was being poorly managed with maximum-tolerance medicines. They are asking for a reduction in the number of prescription drugs.

The study did not involve any patients. Either they had a corneal disease where applanation tonometry would be inaccurate, such as corneal opacity or oedema, or they had an eye condition that would have hindered adequate visualisation and treatment of the TM in the research eye. Who has had glaucoma surgery on the eye under examination before? Who is having eye surgery, such as glaucoma or cataract operations, during the research that could affect IOP? Less than the age of 18.

Every patient underwent a preoperative evaluation. Standard history includes the following information: age, gender, complaint, glaucoma medications, ocular or systemic medications, and any ophthalmological procedures (glaucoma, cataract, or Lasik). Full opthalmological examinations, including measurement of IOP within two weeks of the laser therapy, at least two preoperative IOP measurements were done. We would highly advise considering the mean of two readings taken before the intervention as the baseline IOP.

Pilocarpine nitrate (2%) and brimonidine tartrate (0.2%) were injected into the eye before to laser therapy in order to aid in the visualisation of the TM and prevent IOP rises. Topical benoxinate hydrochloride, 0.4 percent, was used as an anaesthetic throughout the surgery. Additionally, it was administered before the goniolens was used. Laser therapy using the Ellex, SOLO® SLT was used on the patients (Ellex Medical Pty. Ltd, Adelaide, Australia). Its frequency-doubled q-switched Nd:YAG laser emits at 532 nm with a pulse duration of 3 ns and a spot size of 400 m. It was attached to a slit-lamp delivery system. The laser is able to produce pulse intensities between 0.2 and 1.7 mJ. To make it simple to target the treatment area, a low-power helium-neon laser was used as the aiming beam.

Surgery:

The pigmented trabecular meshwork was the target of the aiming beam. One laser pulse was delivered at the 12 o'clock position with the laser energy initially set at 0.6 mJ. The laser intensity was decreased in 0.1 mJ steps if a little fine cavitation bubble (champagne bubbles) emerged, and therapy was then continued at this energy level. If there was no sign of a cavitation bubble, the pulse energy was first raised in 0.1 mJ increments until a bubble appeared, and then it was decreased as previously described. A single 360-degree TM with a non-overlapping laser spot was administered to all eyes by SLT. The average number of selective laser trabeculoplasty procedures was 98.02 ± 3.13 (range, 92–102) and a mean energy of 0.83 ± 0.20 (range, 0.6–1.3 mJ).

Postoperative:

Patients had evaluations at various time intervals, including one day, one week, two weeks, three weeks, four weeks, and three, six, and twelve months. IOP, visual acuity, and a slit-lamp examination of the anterior region were all performed at each visit.

The fundus exam and gonioscopy were once more carried out 4 weeks after the initial follow-up. A second visual field was recorded six months following surgery. All significant and minor complications and complaints were noted and properly handled. Prednisolone acetate (1%) drops used once in the affected eye after the laser treatment and then three times daily for three days. Also, manage the postoperative IOP increases with alpha- agonist eye drops. The treated eye's IOP was measured and recorded one day after surgery. The preoperative anti-glaucoma medicine regimen was maintained until the second postoperative checkup (1 week).

Follow-up:

Prior to surgery and at each follow-up appointment, all ocular drugs were noted. After confirming a sufficient pressure drop, the gradual lowering of anti-glaucoma drugs was started one week after the procedure. When two drugs were used in combination therapy, each medication was reduced independently. Medically necessary medication changes were made at the physician's discretion.

Statistical analysis:

Data on the demographic and clinical traits of every individual recruited was gathered on a data collection sheet. After that, data were kept in Microsoft Excel 365. (Microsoft Corporation, Redmond, Washington, USA). Excel was used for data management, coding, and cleanup as well. Version 26 of SPSS was used for the analysis (IBM Inc., Chicago, Illinois, USA). In a descriptive analysis, continuous data were reported as mean SD, range [min - max], and categorical variables were provided as frequencies and percentages. Chi2 was used in inferential analysis to find associations between categorical variables, and the Mann-Whitney U test was used to compare means in continuous variables across pre- and post-intervention, cases, and controls (to compare two independent groups). The confidence interval level was set to 95%, and a corresponding p value threshold was identified as 0.05, where any output p below 0.05 would be interpreted as an indicator of statistical significance.

RESULTS

In the current study, 86 eyes from 51 patients were included; 43 eyes from 27 patients were designated as the laser intervention group, while another 43 eyes from 24 subjects served as the control group (on anti-glaucoma medication).

The mean ± SD range of age in the intervention group was 52.8 ± 8.5 [38–72], while it was 58.4 ± 7.1 [46–74]. Meanwhile, 15 (55.6%) were male, while 12 (44.4%) were female. In the control group, 11 (45.8%) were male and 13 (54.2%) were female. More details are shown at Table 1.

Table 1: Demographic data in the intervention and control groups.

Demographic data		Intervention group		Control group		Test of Significance
Age range		38 – 72		46 – 74		
Mean ±SD		52.84 ± 8.53		58.37 ± 7.09		p = 0.003*
Gender	Male	15	55.6%	11	45.8%	p =0.4882
	Female	12	44.4%	13	54.2%	
Eye	Right	23	53.5%	22	51.2%	p =0.829
	Left	20	46.5%	21	48.8%	

The mean number of glaucoma molecules after SLT decreased from 1.79 ± 1.30 after 1 year to 0.63 ± 0.79 with a statistically significant difference all over the follow-up time ($p < 0.001$). Table 2 shows the change in the mean number of glaucoma molecules during the study.

Table 2: Shows the mean number of glaucoma molecules pre- and post-SLT in the intervention group.

Time interval	IOP (mmHg) (Mean ± SD)	Test of significance
Basic IOP	1.79 ± 1.30	-
1 Month	1.19 ± 0.96	p < 0.001**
3 Months	0.56 ± 0.70	p < 0.001**
6 Months	0.44 ± 0.67	p = 0.011*

12 Months	0.63 ± 0.79	p < 0.001**

The mean number of glaucoma molecules in the control group grew from 1.63 ± 1.05 prior to the last follow-up visit to 1.97 ± 0.77, which statistically varied during the follow-up period. Table 3 shows the change in the mean number of glaucoma molecules over the course of the study.

Table 3: shows the mean number of glaucoma molecules in the basic until post-1 years in the control group.

Time interval	IOP (mmHg) (Mean ± SD)	Test of significance
Basic IOP	1.63 ± 1.05	
1 week	1.77 ± 0.72	p = 0.898
1 month	1.88 ± 0.73	p = 0.070
3 Months	1.95 ± 0.72	p = 0.025*
6 Months	1.93 ± 0.76	p = 0.046
12 Months	1.98 ± 0.77	p = 0.012*

The mean number of glaucoma molecules before SLT was a statistically insignificant difference compared to the basic control group (p = 0.279). The mean number of glaucoma molecules after SLT treatment from the third month up to the end of follow-up was a statistically highly significant difference compared to the control group (p < 0.001) as shown at Table 4 and Fig. 1.

Table 4: Shows the comparison of the mean number of glaucoma molecules at baseline and post-follow-up in patients in the intervention and control groups.

		Treatment group (Mean ±SD)	Control group (Mean ±SD)	Test of significance
No. of a molecule.	**Basic**	1.79 ± 1.30	1.63 ± 1.05	p = 0.279
	1 month	1.19 ± 0.96	1.88 ± 0.73	p = 0.889
	3 Months	0.56 ± 0.70	1.95 ± 0.72	p < 0.001**
	6 Months	0.44 ± 0.67	1.93 ± 0.76	p < 0.001**
	1 year	0.63 ± 0.79	1.98 ± 0.77	p < 0.001**

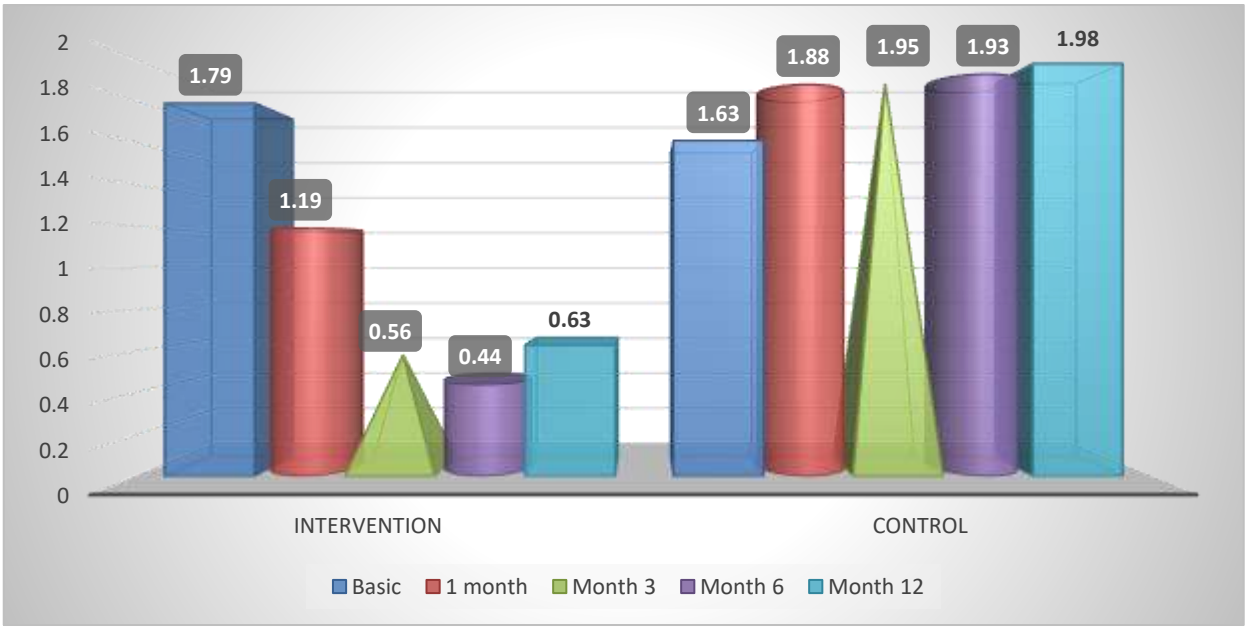

Fig. 1: shows the comparison of the mean number of glaucoma molecules at baseline and post-follow-up in patients in the intervention group and the control group.

The SLT group started with 12 eyes (27.9%) having no medications, 2 eyes (4.7%) were already using one drop, 15 eyes

(20.8%) were using 2 drops, 11 eyes (12.5%) were using 3 drops, and 3 eyes (12.5%) were using 4 drops. The two molecules were most frequent at the start of the intervention (32.6%), and the zero molecule was most prevalent at the end of the intervention (53.5%), whereas the three molecules were most prevalent at the start (41.9%) and in the final follow-up (48.8%) of the control trial. Table 5 provide details on comparing the number of glaucoma molecules used among intervention and control groups at baseline and during follow-up.

Table 5: Shows the changes in the number of glaucoma medications in the intervention and control groups.

No. of a Molecule	No. of Patient			
	Intervention		Control	
	Basic (%)	1 year (%)	Basic (%)	1 year (%)
0	12 (27.9)	23 (53.5)	8 (18.6)	0 (0.0)
1	2 (4.7)	13 (30)	9 (20.9)	12 (27.9)
2	15 (32.6)	6 (14)	18 (41.9)	21 (48.8)
3	11 (25.6)	1 (2.3)	7 (16.3)	9 (20.9)
4	3 (9)	0 (0)	1 (2.3)	1 (2.3)

The control group received more adjuvant medication via follow-up to attain the goal IOP than the intervention group. Table 6 and Fig. 2 provide a comparison of the number of eyes that needed adjuvant medical treatment in the intervention group and the control group.

Table 6: Shows the number of eyes that needed adjuvant medical treatment at the last follow-up in each intervention and control arm.

	Treatment group	Control group	Test of significance
No. of an eye	2	12	
%	4.65 %	27.91 %	0.0045**

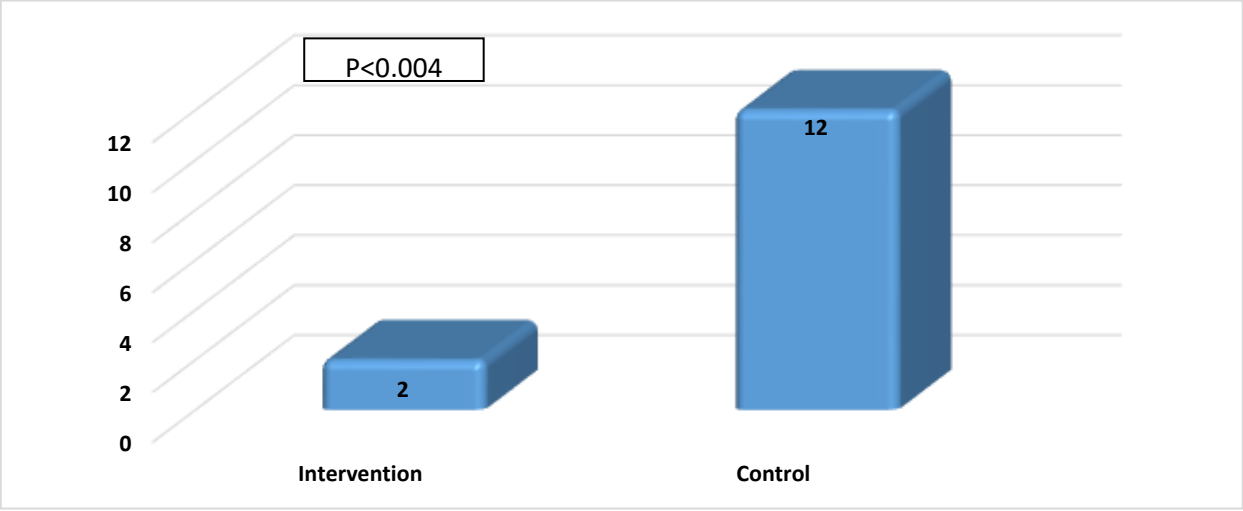

Fig. 2: Shows the comparison of a number of eyes that needed adjuvant medical treatment in the intervention group and the control group.

Conjunctival hyperemia (redness and injection) was encountered in three eyes (7%). Ocular pain or discomfort on the first day after SLT was encountered in nine eyes (20.9%). Mild anterior chamber flare, photophobia, and transient blurred vision were encountered in one eye (2.3%). IOP spikes of more than five mmHg were recorded in one eye (2.3%).

DISCUSSION

Prostaglandin analogues (PGAs) and SLT have been thought to share a common mechanism of action. So it is reported to be equally efficacious as a first-line medication 8. In some studies comparing PGAs and SLT for lowering IOP, both methods had comparable efficacy 19. SLT has been found to be an effective first-line treatment for OAG and is generally well tolerated, with minimal serious adverse effects 20. In addition, used as replacement therapy where, after 18 months, SLT was very able to replace medical care in 77 percent of the trial's eyes 14. Two meta-analyses published in 2015 21, 22 both demonstrate that 360-degree SLT reduces intraocular pressure similarly to either prostaglandin analogue monotherapy or combination therapy 12.

Kara et al. 23 stated that, due to the possibility of conflicting routes, SLT might not be effective when used in conjunction with PGAs, which was also supported by Mansouri and Shaarawy, who reported that using glaucoma drops could possibly interfere with the laser effect 24. In contrast, Singh et al. 25 and Sayin et al. 26, suggest that the use of topical PGAs has no impact on the effectiveness of SLT in decreasing IOP. Soboka et al. 27 reported that there was no significant correlation between being on anti-glaucoma medication and laser IOP reduction on the final visit. The vast majority of trials have addressed the post-SLT reduction in IOP. Fewer studies have examined the ability of SLT to act as replacement therapy as the main outcome measure 28.

In our study, all eyes were done by SLT and received a single 360-degree TM with a non-overlapping laser spot. Selective laser trabeculoplasty was performed with a mean of 98.02 ± 3.13 (range, 92–102) and a mean energy of 0.83 ± 0.20 (range, 0.6–1.3 mJ).

The mean number of glaucoma molecules before SLT was a statistically insignificant difference compared to the basic control group ($p = 0.279$).

In our study, the mean number of glaucoma molecules after SLT decreased from 1.79 ± 1.30 after 1 year to 0.63 ± 0.79 with a statistically significant difference all over the follow-up time ($p < 0.001$). While in the control group, mean glaucoma molecules increased from 1.63 ± 1.05 to 1.98 ± 0.77 at the end of follow-up and showed a statistically significant variation. Of the 12 eyes that began to exhibit an increase in IOP between the third and sixth months, eight of them required the use of one topical glaucoma treatment, and four required the use of more than one medication.

The mean number of glaucoma molecules after SLT treatment from the third month up to the end of follow-up was a statistically highly significant difference compared to the control group ($p < 0.0001$).

SLT significantly reduced the amount of anti-glaucoma medication required while maintaining adequate control. After 12 months, SLT treatment had completely replaced anti-glaucoma medication (full replacement) in 23 eyes (53.5%). Partial replacement (reduction in drugs) was achieved in all other cases. With the exception of two of the new cases, no patient continued to use the same amount of medications following SLT, in line with the findings of the De Kayser et al., study 29.

In our study, the number of eyes requiring adjuvant treatment to control IOP was 2 in the intervention group and 12 in the control group.

These findings are comparable to those of De Kayser et al., 29. At 12 months, they lowered the number of medications from a mean of 1.50 ± 0.85 to 0.35 ± 0.70, while their control group reduced the number of medications from a baseline of 1.41 ± 0.71 to 1.41 ± 0.77. This decrease in glaucoma medications is consistent with Babighian et al., 30 who found a decrease in the mean number of glaucoma medications from 2.20 ± 0.7 to 0.87 ± 0.8. In the Abdelrahman et al. 31 study, the number of drugs used by patients decreased dramatically from 2.25 ± 0.97 prior to laser treatment to 1.00 ± 1.3 at the end of follow-up. These findings are analogous to those published by Francis et al. 32, showing a decrease in the number of medications after SLT from 2.8 ± 1.1 to 1.5 ± 0.9 at 12 months postoperatively. Furthermore, these findings were almost identical to those of Soboka et al. 33, where medicine was reduced from 1.29 ± 1.01 to 0.26 ± 1.34. In terms of the number of drugs lowered, our findings compare satisfactorily with those of other SLT research.

In our study, in contrast to best corrected visual acuity (BCVA) due to developing of cataract, the C/D ratio, mean standard deviation (MSD), and pattern standard deviation (PSD) of VF did not change significantly between pre- and post-study, either in the control or intervention groups. A gonioscopy failed to find any scarring or peripheral anterior synechiae development. This demonstrates how solid SLT's safety profile is.

In the past, while evaluating SLT, the results of IOP reduction have been used as a stand-in for glaucoma stability. The LiGHT study (2019), however, went a step further and contrasted the visual field results between patients who underwent SLT and those who got medication. They found that after monitoring eyes for a median of 48 months, those who had been given medicine at random had a 43% (11% - 83%; $p = 0.005$) higher probability of undergoing moderate to rapid visual field progression (worse than 0.5 dB/year) than those who had had SLT 12.

In our study, after SLT, there were no significant acute complications in the intervention group, and any mild complications that did develop could be managed with topical prednisolone for only three to five days.

According to our findings, SLT is likewise better than medication when there is statistically significant difference in the outcome of number of medications between two groups (intervention and control groups) ($p < 0.001$).

In our study, after SLT, there were no significant acute complications in the intervention group, and any mild complications

that did develop could be managed with topical prednisolone for only three to five days.

Conjunctival hyperemia (redness and injection) was seen in three eyes (7%) but disappeared after three days. This were similar to Sayin et al.26 and Latina et al.34, who reported conjunctival redness in 9% of the eyes in their study.

Ocular pain or discomfort was encountered in nine eyes (20.9%) on the first day following SLT; this is almost identical to Sayin et al.'s 26. This proportion is very comparable to that described by Latina et al.34, who found that 15% of patients had pain or discomfort following SLT, while 23.5% reported experiencing little discomfort during SLT Koucheki and Hashemi, 35. In contrast, Kara et al. 36 found that 33.3%; and Nagar et al. 37 found that 39% of patients receiving 360° SLT experienced transitory pain and discomfort.

One eye (2.3%) experienced a mild anterior chamber flare, photophobia, and transient impaired vision, which subsided after three days. However, Kara et al. 36 reported 10.4%, while McIlraith et al. 38 reported a mild anterior chamber flare in only 4% of cases. We encounter only one case. The decreased number of complicated cases may be explained by the regular use of pre- and postoperative steroids in our practice.

In the current study, one eye (2.3%) had IOP increases of more than five mmHg. Abdelrahman et al. 31 found a comparable finding. Three of the 101 eyes (2.3%) received treatment.

Li et al.22, in their meta-analysis study, found that all studies described common side effects like iritis (anterior chamber reaction), discomfort, redness, and pain as passing quickly and without sequalae.

CONCLUSIONS

SLT is a good method for replacing or reducing glaucoma medications in cases of POAG, which is better for decreasing exposure to the local and systemic side effects of drugs and has an economic advantage in developing countries.

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