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Predictors of Initial Glaucoma Therapy: Laser Trabeculoplasty Versus Medication

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Abstract

Background: Glaucoma is the most common cause of blindness in the world. If not recognized and treated early enough, open-angle glaucoma can be a severe ocular illness that can lead to blindness. A gradual loss of ganglion cells leads to the optic nerve head cupping, which is the pathogenic process. Objective: The main aim of this study was to determine if selective laser trabeculoplasty (SLT) is superior to topical medication as the first-line treatment for open-angle glaucoma. **Material & Methods:** This prospective comparative study was conducted in 225 patients (450 eyes) at Deen Mohd. Eye Hospital & Research Center from July 2019 to July 2021.The patients were randomly divided into two groups; Selective laser trabeculoplasty (SLT group)and medical therapy group. **Results:** The study was conducted between 25 to 85 years of patients where the majority were between 46 to 65 years age group;58% patientswere male, and 42% were female. The mean intraocular pressure (IOP) was 18.2mm Hg for the SLT group and 17.6mm Hg for the medical therapy group. Overall, mean pressures and IOP lowering were not statistically different between the two treatment groups. **Conclusions:** In the last follow-up, 11% of the eyes had been stepped to additional SLT in the SLT arm, and 27% of the eyes in the medical arm required more medications to reach the target IOP range. The main risk factor is high intraocular pressure; however additional potential risk factors include optic nerve vascular insufficiency, neuronal degeneration, and hereditary factors. More research and prospective trials on intraocular pressure control and disease progression are needed to understand the long-term implications.

Keywords:- Glaucoma therapy, Laser trabeculoplasty, Open-angle glaucoma, intraocular pressure.

INTRODUCTION

Glaucoma is one of the world's most common causes of irreversible blindness.[1] In 2010, more than 60 million people were affected, with 8.4 million of them becoming blind on both sides due to the disease. Glaucoma will affect 79.6 million individuals worldwide in 10-12 years, with 74% of those suffering from open-angle glaucoma (OAG).[2] The goal of OAG therapy is to keep the optic nerve healthy by lowering IOP. There are now three options for achieving this goal: medicines, laser treatments, and surgery.[3] Medication is usually the first line of defense when it comes to lowering IOP.For regulating IOP, a variety of potently hypotensive topical medications is currently available.[4]

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On the other hand, medication has several possible drawbacks, both in the drug itself and its preservatives. Patients must bear the expenditures of continued medical care, as well as the adverse effects of medications and the need for frequent application.[5] Selective laser trabeculoplasty (SLT) was introduced as a new non-invasive option for lowering IOP in eyes with OAG.[6] This treatment involves placing laser spots in the trabecular meshwork, which causes an increase in outflow capacity and, as a result, a decrease in IOP. In a recent Cochrane systematic review of laser trabeculoplasty, only one trial comparing SLT to medicine was included, preventing a meta-analysis at the time.[3] In a recent meta-analysis comparing SLT with argon laser trabeculoplasty (ALT) in the treatment of OAG, the role of medication was not assessed.[7] As a result, SLT is more dependable than conventional medications.Despite the introduction and widespread usage of beneficial drugs such as topical prostaglandin analogs, beta-blockers, alpha-agonists, and carbonic anhydrase inhibitors, a quarter of patients treated for 20 years have progressed to blindness in one eye.[8] Patients with glaucoma can go blind for various causes, one of which is failure to follow medical treatment instructions. Electronic monitoring and evaluating prescription refill rates show that many individuals do not take their medications as prescribed.[9,10] Non-adherence can be due to various factors, including forgetfulness, physical incapacity to position eye drops, medicine side effects, health views, and the expense of medication. In 2004, the total cost of care for glaucoma patients was estimated to be $2.9 billion, with most of the money going on pharmaceuticals and outpatient treatments.[11]

The use of laser trabeculoplasty or trabeculectomy in the treatment of glaucoma has been demonstrated in several trials. Both the Glaucoma Laser Trial (GLT) and the Collaborative Initial Glaucoma Treatment Study were large National Eye Institute prospective multicenter trials that compared initial medical therapy with laser trabeculoplasty and trabeculectomy (CIGTS).[6,7,8] IOP therapy with laser trabeculoplasty or trabeculectomy was as successful in maintaining IOP reduction as a single medication.Other lasers have been researched for angle applications since Wise and Witter presented argon laser trabeculoplasty (ALT) for the treatment of OAG.[9,10] The use of a frequency-doubled Nd:YAG laser, whose wavelength enables for selective photothermolysis of melanin while preserving non-pigmented tissue, was defined by Latina and Park.[11] A scanning electron microscope investigation revealed that the selective laser caused no thermal harm when aimed at the trabecular meshwork of human cadaver eyes, in contrast to the usual thermal melt found when pointing the argon laser at the trabecular meshwork of human cadaver eyes.[12] Patients uncontrolled by medicinal treatment had an additional reduction in IOP in the initial clinical studies with selective laser trabeculoplasty (SLT).[13,14,15,16,17,18]

Objective

The main objective of this trial was to see whether selective laser trabeculoplasty (SLT) is a better first-line treatment for open-angle glaucoma than topical medicine.

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MATERIAL AND METHODS

A total of 225 patients were included in thisprospective comparative study. In this study, the patients were randomly divided into two groups (either the SLT group or topical medical therapy group). Table 1 shows the study design specifically.

Table 1: Study design

Type of Study	Place of Study	Period of study
A prospective comparative study.	Deen Mohd. Eye Hospital & Research Center	July 2019 to July 2021

Sample size:

This prospective comparative study was conducted on a total of 225 patients (450 eyes).

SLT group: 119 patients (238 eyes)

Medicine/Drop group (topical medical therapy):106 patients (212 eyes)

Inclusion criteria

- Patients between 35-85 years of age with IOP ≥ 24 and ≤ 31
- Diagnosis of primary OAG (Mild/Moderate)not yet used any antiglaucoma drop
- OAG uncontrolled on medical treatment with 1 or 2 drops
- Pseudoexfoliation glaucoma
- Pigmentary OAG
- Diagnosis of ocular hypertension
- No previous intraocular surgery
- Pregnant woman with OAG

Exclusion criteria

- Patients on >2 glaucoma medications
- Had a CIGTS visual field score that exceeded 16 in either eye.
- Evidence of ocular disease other than glaucoma or ocular hypertension.
- Diagnosis of OAG with proliferative diabetic retinopathy

Data collection:

A group of clinicians gathered medical records by interviewing patients directly after obtaining written informed consent and hospital records.

Statistical analysis:

All statistical analysis was carried out using excel and SPSS (Statistical Program for scientific study) version 25 statistical packageanalysis tool. Frequency and percentages are presented for the categorical variables, and mean±standard deviation and median are given for the continuous variables. P-value <0.05 was considered significant in our study.

RESULTS

A total of 225 patients (450 eyes) was enrolled in this study, and180 patients reached the 20 to 24-months follow-up window. The remaining 45 patients were not included in this analysis because they had not reached the time endpoint at the termination of the study. The data regarding the rate of marital status, glaucoma in the immediate family, glaucoma

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in the distant family, hypertension, diabetes, and smoking historyof patients were included here. [Table 2] shows the demographic data of all the patients.

Table 2: Demographic data of the patients

Variables	Medicine group (n=106)		SLT group (n=119)		P value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Material status					
Married	63	28%	60	50.42%	0.31
Unmarried	43	19.1%	59	49.58%	
Glaucoma in the immediate family					
Yes	45	42.45%	58	48.74%	0.67
No	61	57.55%	61	51.26%	
Glaucoma in distant family					
Yes	30	28.30%	50	42.02%	0.89
No	76	77.70%	69	57.98%	
Hypertension					
Yes	31	29.25%	36	30.25%	0.75
No	75	70.75%	83	69.75%	
Diabetes					
Yes	35	33.02%	12	10.08%	0.83
No	71	66.98%	107	89.92%	
Smoking history					
Current smoker	7	6.60%	19	15.97%	0.02
Ex-smoker	18	16.98%	35	29.41%	
Never	81	76.42%	65	54.62%	

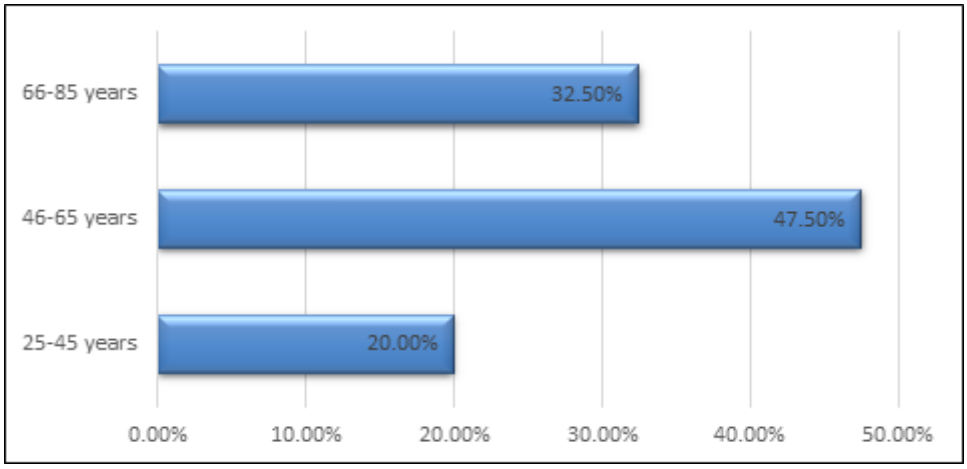

Figure 1: Distribution of age group among the patients.

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Patients included in this study were between 25-85 years of age [Figure 1]. The majority of the patients belong to the 46-65 years age group. Moreover, the least amount of patients was from the 25-45years of age range. The mean and Standard deviation of the patients was 62.4±10.9.
[Figure 2] Shows that among the 225 patients, 58% (130) were male, and 42% (95) were female.

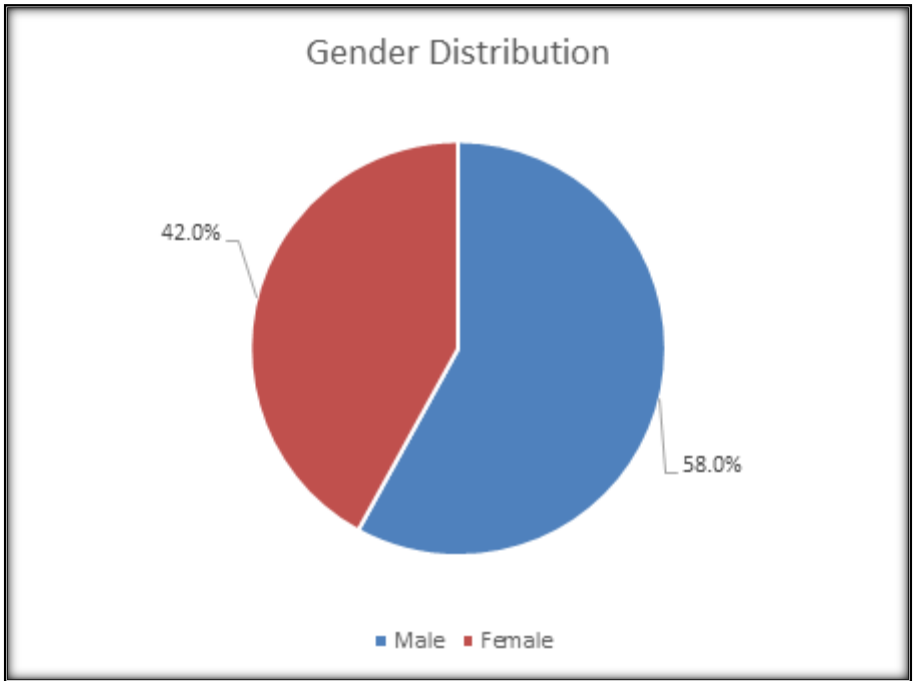

Figure 2: Gender distribution of the patients.

[Table 3] shows the follow-up results for all the 225 patients enrolled in this study. Including those, 45 reached 4 to 6 months follow-up, and 180 patients reached 9 to 12 months of follow-up.

Table 3: Changes of IOP at baseline and follow-up

Variables	Baseline	Follow-up (4 to 6 months)	Follow-up (9-12 months)
Medicine group			
Left eye	22.9	19.2	18.8
Right eye	22.6	18.6	17.9
SLT group			
Left eye	23.4	20.2	19.5
Right eye	25.7	19.9	19.3

[Table 4] shows the overall mean IOP for both eyes at baseline for the SLT and medical groups, 25.2 and 24.6mm Hg, respectively. In addition, at the 6 and 12-month follow-up periods, the mean IOP for both eyes for each treatment group is shown. The mean pressure in the SLT group was 18.2mm Hg

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(6.3mm Hg reduction) at the last visit, while in the medical arm, it was 17.6mm Hg (7.0mm Hg reduction). Overall mean pressures and IOP reduction did not differ statistically between the two treatment groups.

Table 4: Changes of IOP at baseline and follow-up

Variables	Baseline	Follow-up (4 to 6 months)	Follow-up (9-12 months)
Medicine group			
IOP	24.6 (±2)	17.9 (±3.1)	17.6 (±2.9)
IOP change		6.4 (±2.5)	7.1(±1.9)
Months of follow up		5.8 (±1.2)	11.5(±0.7)
SLT group			
IOP	25.2 (±2.1)	18.8 (±2.7)	18.2 (±2.9)
IOP change		6.1 (±3.2)	6.3 (±2.6)
Months of follow up		6.7 (±1.0)	12.3 (±1.7)

The number of treatment steps and the percentage of eyes that met the target IOP values are shown in [Table 5]. By the last follow-up, 11% of the eyes in the SLT arm had been stepped up to more SLT, whereas 27% of the eyes in the medical arm needed extra medicines to meet the target IOP range.

Table 5: Distribution of Number of Steps by Treatment Group

Variables	4 to 6 months		9 to 12 months	
	Medicine group	SLT group	Medicine group	SLT group
Single treatment	90	103	72	83
Double treatment	11	9	7	9
Double treatment in the left eye only	3	0	1	2
Double treatment in right eye only	2	6	0	4
Triple treatment	0	1	0	2
Percentage met target IOP				
Right eye	126 (56%)	106 (47%)	126 (70%)	103 (57%)
Left eye	97 (43%)	108 (48%)	111 (62%)	97 (54%)

DISCUSSION

There are several concerns about chronic medical treatment for glaucoma:

1. Suspected lack of medication adherence;
2. Glaucoma drug side effects;
3. Wide variations in IOP due to trough effects or not using drugs at appropriate times; and
4. Worsening the guess of glaucoma surgery due to ocular surface-induced changes.

A variety of studies using a questionnaire, electronic surveillance, and persistency refill data have convincingly demonstrated

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widespread noncompliance with glaucoma medication therapy.[8,9] Many glaucoma patients have minimal adherence to medical treatment, prompting physicians to devise ways to improve compliance by selecting well-tolerated medications,[23,24,25,26] limiting dose schedules, simplifying drug regimens, and offering patient education and reinforcement.Concern has been expressed about ocular surface modification resulting from long-term glaucoma drug administration, which could compromise drug tolerance and filtration surgical success.[27,28] Several prospective randomized trials, including the Advanced Glaucoma Intervention Study,[29] the CIGTS,[8] and the GLT,[6,7] have called into question the traditional treatment paradigm for OAG. The possibility of using ALT as an initial treatment rather than conventional medical treatment was investigated in the latter trial.

The destructive thermal action of ALT on the trabecular meshwork, which destroys the outflow mechanism in the vicinity of each thermal, coagulative ALT application, has been identified as a source of concern. This could have long-term consequences for illness progression and response to medical treatment. Due to the poor response to repeat ALT and concerns about thermal injury-induced scarring of the outflow system,[30,31] various laser wavelengths for trabeculoplasty have been investigated, such as the frequency-doubled Nd:YAG (SLT) laser.In human tissue studied with a scanning electron microscope, SLT has no detectable thermal effects compared to ALT.[12] SLT, unlike many other therapies that do not address the underlying pathophysiology of OAG, is thought to renew the trabecular meshwork and enhance outflow.[32]

Patients were randomly assigned to either SLT or pharmacological therapy in this trial, removing any concerns about glaucoma medicines having cross-over effects. At the last follow-up visit, the SLT group had lowered IOP 26.4%, and the medicinal arm had lowered IOP 27.8%, indicating that the two groups' efficacy was equivalent. The goal of this study was to track the effects of IOP decreasing for a year. Previous studies have compared SLT and ALT as supplementary therapy to medicines in a retrospective study and prospective series,[20,21,22] all of which concluded that they were equally effective.SLT has recently been employed as the principal therapy in three prospective studies,[33,34] with IOP reductions of roughly 30% below untreated baseline levels, comparable to prostaglandin reductions of IOP. Melamed et al.[33] and McIlraith et al.[35] reported an 8mm Hg drop in IOP with SLT in their nonrandomized investigations.

In their study, Matthew P Quinn et al. included 194759 patients. Women were more likely than men to be treated with LT rather than medication (81 years of age vs. 66-70 years of age: OR, 0.49; 95% confidence interval [CI], 0.48-0.50), while older patients were less likely to be treated with LT rather than medication (81 years of age vs. 66-70 years of age: OR, 0.49; 95% confidence interval [CI], 0.48-0.50). (OR, 1.42; 95% CI, 1.39-1.45). Cataract surgery (OR, 0.31; 95% CI, 0.30-0.32), corneal transplantation (OR, 0.39; 95% CI, 0.31-0.49), and retina surgery (OR, 0.39; 95% CI, 0.31-0.49) were also linked to a lower likelihood of receiving LT treatment (OR, 0.46; 95% CI, 0.41-0.51). Patients who had many comorbidities were less likely

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to get LT (highest vs. lowest level of comorbidity: OR, 0.94; 95% CI, 0.91-0.97). Patients with a higher SES (highest vs. lowest level: OR, 0.86; 95% CI, 0.84-0.89) and who lived in a rural area were less likely to use laser trabeculoplasty (versus urban: OR, 0.92; 95% CI, 0.90-0.95). Over time, there has been an increase in LT use (for each additional calendar year: OR, 1.05 per year; 95% CI, 1.05-1.05 per year).[36]

CONCLUSIONS

The efficacy of initial laser trabeculoplasty treatment was comparable to that of initial topical drug treatment. SLT, we feel, is a safe and well-tolerated outpatient technique for decreasing IOP sufficiently in chosen individuals with OAG. The main risk factor is high intraocular pressure; however additional potential risk factors include optic nerve vascular insufficiency, neuronal degeneration, and hereditary factors.In a long-term follow-up prospective clinical investigation, the duration of the IOP-lowering impact must be studied. Because glaucoma is a chronic condition, longer-term outcome data will be required to create the basis for particular therapy recommendations.

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