Al-Azhar International Medical Journal

Volume 4 | Issue 5 Article 9

2023
Section: Ophthalmology

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How to Cite This Article

Saady, Mohamed Fayez; Sayed, Sayed Abbas; and Ibrahim, Anas Malek (2023) "Efficacy of micropulse (subthreshold) argon laser trabeculoplasty in primary open angle glaucoma," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 5, Article 9.
DOI: https://doi.org/10.58675/2682-339X.1828

ORIGINAL ARTICLE

Efficacy of Micropulse (Subthreshold) Argon Laser Trabeculoplasty in Primary Open-angle Glaucoma

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Abstract

Background: **Primary open-angle glaucoma (POAG) is an adult-onset, slowly progressing optic neuropathy characterized by the atrophy of the optic nerve and the death of retinal ganglion cells and their axons over time, The introduction of micro pulse laser trabeculoplasty (MLT) has allowed for the safe and effective treatment of several retinal maculopathies. This is achieved using a duty cycle algorithm that provides subthreshold therapy to ocular tissues without scar formation.**

Objective: **Evaluation of subthreshold MLT efficacy in primary open-angle glaucoma management.**

Methods: **We conduct a randomized prospective case series study of primary open-angle glaucoma cases. Including 40 eyes of patients with primary open-angle glaucoma. This research was carried out at Bab El-Sharea University Hospital's Ophthalmology Department.**

Results: **This investigation comprised 40 patients' eyes. Patients mean age was 55.50 ± 6.78 years. 12 patients were males and 28 females. Cup−disc ratio mean pretreatment was 0.56 ± 0.083 all the patients were on medications. Per-session, on average, 120 burns were administered. The average preintraocular pressure was 19.50 ± 2.26 and the postlaser intraocular pressure (IOP) at second hour postlaser, first day, first week, fourth week, 12th week, 24th week, 18.75, 18.70, 17.20, 16.15, 16.20, 15.90 mmHg, respectively. The mean reduction in IOP (%) at the first day, 1 week, 4 weeks, 12 weeks, and last follow-up was 4.1%, 12%, 17.2%, 16.9%, 18.5%. There is a clinically significant difference between mean the base line IOP and the postlaser intraocular pressure at different follow-up times except after first day where there are no clinically significant differences.**

Conclusion: **Subthreshold micro pulse trabeculoplasty is a safe procedure has no eye complications. It is effective as an adjuvant treatment in patient with primary open-angle glaucoma. As MLT has no eye complications it can be repeated safely if the response is poor after three months or IOP got elevated later. It is effective as a first-line therapy for open-angle glaucoma, especially normal-tension glaucoma.**

Keywords: Argon laser trabeculoplasty, Efficacy of micropulse, Primary open-angle glaucoma

1. Introduction

About 8% of all blindness is caused by glaucoma, making it the main cause of permanent blindness and the second greatest cause of blindness globally. Progressive optic neuropathy, acquired atrophy, and the death of retinal ganglion cells and their axons are all symptoms of the chronic condition known as primary open-angle glaucoma. By gonioscopy, an open anterior chamber angle is linked with this disease. The most important risk factor is elevated intraocular pressure.[1]

Retinal nerve fiber layer injury and visual field loss can be avoided if intraocular pressure (IOP) is reduced.[2] Using topical antiglaucoma drugs prior to surgery can help reduce IOP and reduce the risk of complications.[3]

Wise and Witter, in 1979, documented the first laser trabeculoplasty using an argon laser.[4]

Selective laser trabeculoplasty (SLT) was first used by Latina and Park in 1995.[5] After then, both became commonplace in the management of open-angle glaucoma (OAG), showing promise in lowering IOP and avoiding the negative effects of topical drugs.[6]

Multiple studies have demonstrated that the two methods are equivalent in their success rates. SLT, on the other hand, has the benefits of not scarring the trabeculum and being easily repeatable.[7] Micro

Accepted 15 November 2022.
Available online 27 September 2023

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https://doi.org/10.58675/2682-339X.1828

pulse laser trabeculoplasty (MLT) is a relatively new technique used to treat a variety of retinal maculopathies. It employs a duty cycle algorithm to give subthreshold therapy to ocular tissues without scar formation, making it safe to put the laser even directly over the fovea.[8]

Inducing a biological reaction in the trabecular meshwork with minimum damage to the trabeculum in a shorter amount of time than would otherwise be possible due to the heat diffusion to surrounding tissues. Concerns remain about its effectiveness.[8]

So, our study aim was evaluation of subthreshold MLT efficacy in primary open-angle glaucoma management.

2. Patient and method

We conduct a randomized prospective case series study of primary open-angle glaucoma cases. Including 40 eyes of patients with primary open-angle glaucoma. This research was carried out at Bab El-Sharea University Hospital's Ophthalmology Department.

2.1. Inclusion criteria

Individuals over the age of 20 who have been diagnosed with primary open-angle glaucoma and are receiving either the best medical therapy possible or no treatment at all are considered primary cases.

2.2. Exclusion criteria

Patients having a history of laser trabeculoplasty, cyclophotocoagulation, or other glaucoma operations, as well as those with secondary glaucomas: as congenital glaucoma, juvenile open-angle glaucoma, neovascular glaucoma, end stage glaucoma angle-closure glaucoma as well as Uveitic glaucoma.

(1) Complete ophthalmological examination before laser procedure including: Goldmann's applanation tonometry for intraocular pressure recording; slit-lamp examination; Goldmann's 3-mirrors contact goniolens for angle examination (Fig. 1), best corrected visual acuity, retina and optic disc evaluation, visual field.
(2) Informed consent the patients signed a consent for procedure including, advantages, disadvantages and risks of possible complications.
(3) Procedure technique and follow-up of MLT conducted with the IRIS Medical Oculight SLx 532 IQ Argon Laser System (IRIDEX Corporation, Mountain View, CA, USA). Immediately before to the MLT procedure, the patient's eyes were numbed with two drops of topical anesthetic (0.4% benoxinate). Patients sat at the slit-lamp, and an inner face guide and a specific MLT lens were used to accurately fire 10 confluent laser pulses into the eye every hour. The MLT Mode selected a spot size of 300 m, a power of 1000 mW, a duration of 300 ms, and a duty cycle of 15% (Fig. 2).

Careful attention was paid to directing the laser beam onto the anterior trabecular meshwork, where 120 laser dots were uniformly spaced out over the whole trabecular meshwork. Diclofenac 0.1% eye drops were used immediately after the procedure and for the next five days, three times a day. The patients continued taking the medications they were taking before therapy. After the second hour, first day, 1

Fig. 1. Goldmann 3-mirrors contact goniolens.

Fig. 2. Iridex IQ 532 argon laser apparatus subthreshold micro pulse: showing parameters of laser used in MLT procedure.

week, 4 weeks, 12 weeks and 24 weeks following MLT, intraocular pressure readings were taken.

2.3. Statistical analysis

SPSS (Statistical Package for the Social Sciences) version 22 for Windows was used to enter codes, process data, and generate results (IBM SPSS Inc, Chicago, IL, USA). The Shapiro–Wilk test was used to check if the data followed a normal distribution. Quantitative information was shown as percentages and frequencies. The χ^2 test is used to compare the differences between two or more sets of qualitative data. Calculations were done using a mean and standard deviation format for quantitative data (Standard deviation). Two sets of normally distributed data were compared using the independent samples *t*-test (parametric data). When the probability level was less than 0.05, it was judged to be statistically significant.

3. Results

Table 1 showed the base line demographic characteristics. This investigation comprised 40 patients' eyes. The mean age of the patients was 55.50 ± 6.78 years. 12 patients were males and 28 females. Cup–disc ratio mean pretreatment was 0.56 ± 0.083 all the patients were on medications. Persession, on average, 120 burns were administered. The average preintraocular pressure was 19.50 ± 2.26 and the postlaser IOP at second hour postlaser, first day, first week, fourth week, 12th week, 24th week. 18.75, 18.70, 17.20, 16.15, 16.20, 15.90 mmHg, respectively (Table 1).

Regarding IOP(%) mean reduction at the first day, 1 week, 4 weeks, 12 weeks, and last follow-up was 4.1%, 12%, 17.2%, 16.9%, 18.5% (Table 2).

There was a clinically significant difference between mean the base line IOP and the post-laser intraocular pressure at different follow-up times except after first day where there is no clinically significant differences (Table 3 and Fig. 3).

Table 1. Baseline demographic characteristics (n = 40).

Variables	Mean ± SD
Age	55.50 ± 6.78
Cup/disc ratio	0.56 ± 0.083
Follow-up	24 weeks
Sex	
Male	12 (30%)
Female	28 (70%)
Lens	
Clear	14 (35%)
NS	14 (35%)
N II	6 (15%)
AC.PC	6 (15%)
Medical treatment	
Xalatan	12 (30%)
Twinzole	12 (30%)
Alpha Nova	16 (40%)
IOP (mmHg)	
Preoperative	19.50 ± 2.26
IOP (mmHg)	
Postoperative	
2nd h	18.75 ± 2.31
1st day	18.70 ± 3.31
1st week	17.20 ± 2.26
4 weeks	16.15 ± 2.01
12 week	16.20 ± 2.02
24 week	15.90 ± 1.92

Table 2. Mean intraocular pressure (IOP) with standard deviation, and mean IOP reduction from baseline at various time points up to the last follow-up.

	Base line IOP	Post laser					
		2 h	1 day	1 week	4 weeks	12 weeks	Last follow-up 24 weeks
-No. of patient	40	40	40	40	40	40	40
-Mean IOP(mmHg)	19.50	18.75	18.70	17.20	16.15	16.20	15.90
-Std. Deviation (SD)	2.26	2.31	3.31	2.26	2.01	2.02	1.92
-Minimum - Maximum	15–23	13–22	13–29	12–20	12–19	12–19	12–19
Mean IOP reduction (%)		4%	4.1%	12%	17.2%	16.9%	18.5%

The mean IOP at the beginning of the study was significantly related to the mean IOP at subsequent time points. No adjustments were made to the patients' medication schedules from before therapy began. At the subsequent follow-up, no patients showed any signs of a serious inflammatory response. The pressure never suddenly increased. When we last checked in with our patients, none of them had developed peripheral anterior synechiae. All eyes maintained the same levels of visual acuity (Table 4).

4. Discussion

Invisible, repeating, brief laser pulses are applied to the trabecular meshwork by the subthreshold micropulse laser technology. Each one of these pulses is separated by a substantial period of rest. Micropulse trabeculoplasty uses 15% duty cycle instead of a continuous 100% duty cycle laser wave, so that targeted tissue maintain temperature and remains viable. Also, Trabeculoplasty using micropulse technology does not lead to a coagulative reaction, intraocular pressure spikes, pigment dispersion, or significant inflammatory response.[9]

This prospective case series study set out to see if MLT might successfully reduce pressure in eyes being treated for POAG. The average decrease in IOP from baseline to follow-up in this investigation was 18.5%, which is similar to the results published by Ingvoldstad and colleagues[9] (18.3% reduction in IOP) and greater than the results of prior studies, by Detry-Morel and colleagues[10] with Micropulse diode laser trabeculoplasty (MDLT) showing 12.2% decreases in IOP by the third month. Gossage[11] revealed that at 4 months, the patient's IOP had decreased by 18%, which was the target.

Some studies obtain higher IOP reduction after MPLT, Fea and colleagues[12] performed Micropulse diode laser trabeculoplasty on a group of 20 patients with a 12-month follow-up period; IOP decreased by 21.3%; IOP decreased by greater than 20% in 10/15 eyes (66.7%) as compared with previous research wherein only 35.7% of patients had success with similar reductions. Other researchers, like as Lee and colleagues,[8] found a similar decrease in IOP of 19.5% after 6 months, with 72.9% ($n = 35$) of patients seeing an IOP reduction of 20% or more in the first month.

Recently, Ahmed[13] reported their experience in using MLT with 532 nm wavelength in patients with open-angle glaucoma. The identical spot size (300 m), duration (300 ms), and duty cycle (15%) were employed for all treatments. Nonetheless, they contrasted the results of employing various

Table 3. Mean intraocular pressure (IOP) base line with standard deviation and post laser at various time points up to the last follow-up (paired t-test).

Variables	Paired Differences					t	Significance
	Mean	Std. deviation	Std. error mean	95% Confidence interval of the difference			
				Lower	Upper		
Base line IOP – 2nd hour	0.750	0.638	0.143	0.451	1.049	5.252	0.000
Base line IOP – 1st day	0.800	2.375	0.531	−0.312	1.912	1.506	0.148
Base line IOP – 1st week	2.300	0.656	0.147	1.993	2.608	15.657	0.000
Base line IOP – 4th week	3.350	0.875	0.196	2.940	3.759	17.120	0.000
Base line IOP – 12th week	3.300	0.470	0.105	3.079	3.520	31.389	0.000
Base line IOP – 24th week	3.600	0.502	0.112	3.365	3.835	32.031	0.000

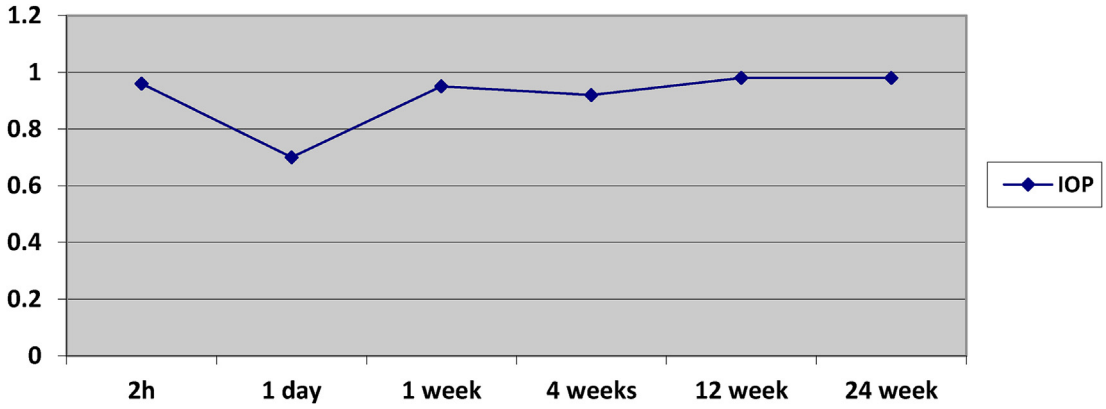

Fig. 3. There was a significant correlation between the mean base line IOP and the mean IOP at different follow-up times.

Table 4. Correlations.

Variables	*N*	Correlation	Significance
Mean Base line IOP & _2nd h	40	0.961	0.000
Mean Base line IOP & 1st day	40	0.697	0.001
Mean Base line IOP & 1st week	40	0.958	0.000
Mean Base line IOP & 4th week	40	0.923	0.000
Mean Base line IOP & 12th week	40	0.982	0.000
Mean Base line IOP & 24th week	40	0.984	0.000

power levels: 13 eyes of 13 patients at 300 mW; 14 eyes of 14 patients at 700 mW; and 15 eyes of 15 patients at 1000 mW (18 eyes of 18 Patients) IOP was shown to be most effectively reduced at 1 and 4 months with a power level of 1000 mW. They thought that the greater force would have a more permanent impact.

4.1. Conclusion

In conclusion, subthreshold micro pulse trabeculoplasty is a safe procedure has no eye complications. It is effective as an adjuvant treatment in patient with primary open-angle glaucoma. As MLT has no eye complications it can be repeated safely if the response is poor after three months or IOP got elevated later. It can be used as primary treatment for open-angle glaucoma particularly normal-tension glaucoma.

We recommend larger number of subjects and follow-up for a longer period of time (years) is required to proof the effect of MLT over time. We need randomize controlled trials to show the response of primary cases without previous medical treatment (virgin eyes) and compare MTP with antiglaucoma medications, ALT or SLT.

Author contribution

Authors contributed equally in the study.

Authorship

All authors have a substantial contribution to the article.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Conflicts of interest

There are no conflicts of interest.

References

1. Weinreb RN, Leung CK, Crowston JG, et al. Primary open-angle glaucoma. *Nat Rev Dis Prim*. 2016;2:1–19.
2. Jammal AA, Thompson AC, Mariottoni EB, et al. Impact of intraocular pressure control on rates of retinal nerve fiber layer loss in a large clinical population. *Ophthalmology*. 2021;128:48–57.
3. Lee DA, Higginbotham EJ. Glaucoma and its treatment: a review. *Am J Health Syst Pharm*. 2005;62:691–699.
4. Damji KF, Bovell AM, Hodge WG, et al. Selective laser trabeculoplasty versus argon laser trabeculoplasty: results from a 1-year randomised clinical trial. *Br J Ophthalmol*. 2006;90:1490–1494.
5. Harasymowycz PJ, Papamatheakis DG, Latina M, et al. Selective laser trabeculoplasty (SLT) complicated by intraocular pressure elevation in eyes with heavily pigmented trabecular meshworks. *Am J Ophthalmol*. 2005;139:1110–1113.
6. Stein JD, Kim DD, Peck WW, et al. Cost-effectiveness of medications compared with laser trabeculoplasty in patients with newly diagnosed open-angle glaucoma. *Arch Ophthalmol*. 2012;130:497–505.
7. Stein JD, Challa P. Mechanisms of action and efficacy of argon laser trabeculoplasty and selective laser trabeculoplasty. *Curr Opin Ophthalmol*. 2007;18:140–145.

8. Lee JW, Yau GS, Yick DW, et al. MicroPulse laser trabeculoplasty for the treatment of open-angle glaucoma. *Medicine*. 2015;94, e2075.
9. Ingvoldstad DD, Krishna R, Willoughby L. Micropulse diode laser trabeculoplasty versus argon laser trabeculoplasty in the treatment of open angle glaucoma. *Investig Ophthalmol Vis Sci*. 2005;46:123, 123.
10. Detry-Morel M, Muschart F, Pourjavan S. Micropulse diode laser (810 nm) versus argon laser trabeculoplasty in the treatment of open-angle glaucoma: comparative short-term safety and efficacy profile. *Bull Soc Belge Ophtalmol*. 2008;308: 21–28.
11. Gossage DD. 532 nm micropulse laser trabeculoplasty successfully lowers IOP as primary treatment. *Iridex Clin Case Rep Ser*. 2014:1–2.
12. Fea AM, Bosone A, Rolle T, et al. Micropulse diode laser trabeculoplasty (MDLT): a phase II clinical study with 12 months follow-up. *Clin Ophthalmol*. 2008;2:247.
13. Abouhussein MA. Micropulse laser trabeculoplasty for open-angle glaucoma. *Delta J Ophthalmol*. 2016;17:80–84.