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RESEARCH ARTICLE

Selective Trabeculoplasty in the Management of Open Angle Glaucoma: Retrospective Analysis at 1 Year

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Abstract

Purpose: The objective of this study was to observe the 1-year pressure gain in a consecutive series of glaucoma patients treated by selective laser trabeculoplasty, along with the clinical and technical characteristics that influence the evolution of intraocular pressure after treatment.

Materials and methods: We carried out a retrospective study of all patients treated in the ophthalmology department of Nancy University Hospital between January 2015 and March 2016. Treatment was performed with a Q-Switched, frequency doubled Nd: YAG laser (Solutis - Quantel Medical, France), over 180° or 360° of the trabecular meshwork. The mean decreases in Intraocular pressure and the success rate (defined as a decrease in intraocular pressure of ≥ 20% at 1 year without increasing the medical treatment) were calculated. The impact of the different clinical and technical characteristics of each case on the decrease in pressure was also studied by bivariate analysis.

Results: One hundred and nineteen eyes, in 78 patients, were included. The decrease in IOP at 1 year was in mean of 4.2 mmHg (Standard Deviation = 5.37), and of 19.6% from baseline. The success rate was 46.7%. Only two minor and reversible complications occurred during the follow-up period.

Discussion: Selective trabeculoplasty is currently a therapeutic option called-upon at different stages in the progression of glaucoma. The duration of efficacy of this laser therapy, and the retreatment frequency are yet to be defined.

Keywords

Open angle glaucoma, Selective trabeculoplasty, Laser

Introduction

In order to prevent the progressive and irreversible loss of optic nerve fibres, the treatment of glaucoma aims to effectively and lastingly reduce Intraocular Pressure (IOP) in affected patients. To this end, in addition to medical and surgical techniques, means of weakening the trabeculum by laser have been developed since the 1980s, following the pilot study by Wise and Witter [1].

The procedure was originally performed using an argon laser. Impacts of 50 µm diameter were applied to the pigmented trabeculum, using wavelengths between 488 and 514 nm with high fluence levels (energy/area) [2,3].

The Latina study, which reported the possibility of targeting only the pigmented cells of the trabeculum using a selective laser delivering low-fluence spots, made possible the development of Selective Laser Trabeculoplasty (SLT) in 1998 [4,5].

This technique uses a Q-Switched, frequency doubled Nd: YAG laser with a wavelength of 532 nm. The impact spot size and duration of the pulses are fixed, respectively 400 µm and 4 ns. The energy level is variable and can be set to values from 0.2 to 2.0 mJ. The energy required to perform SLT is less than 1% than the one used with argon laser trabeculoplasty [6]. Its sub-threshold treatment parameters and its wavelength of 532 nm, highly absorbed by melanin, have the advan-

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tage of targeting the pigmented cells of the trabeculum without generating heat and thus are not damaging surrounding tissues, preserving the trabecular meshwork architecture [2,7].

The reduction in IOP after SLT may be explained, besides the mechanical opening of the trabeculum and the canal of Schlemm, by cellular and biochemical mechanisms favouring the drainage of the aqueous humour [8,9].

The aim of our study was to observe the 1-year pressure gain in a consecutive series of glaucoma patients following SLT laser treatment, as well as the clinical and technical characteristics that may have an impact on the efficacy of the treatment.

Materials and Methods

Design

We carried out a retrospective study including all glaucoma patients having received SLT laser treatment in the ophthalmology department of the Nancy University Hospital between January 2015 and March 2016.

Sample

The inclusion criteria were as follows, patients over 18 years of age, with open-angle glaucoma, with uncontrolled IOP or intolerance to topical drug therapy, including certain patients for whom the laser was proposed as first-line treatment in order to best preserve their ocular surfaces. The patients had to have an open irido-corneal angle in order to allow the laser treatment implementation (chronic primary open-angle glaucoma, pseudo-exfoliative or pigmentary glaucoma, post-traumatic glaucoma and corticosteroid-induced glaucoma). Patients under the age of 18 were excluded from the study, as were patients who had Already undergone Laser Trabeculoplasty (ALT or SLT) in the past. Both eyes could be included.

Data collection

For each patient we recorded the following characteristics: Age, ethnicity, sex, side treated (left/right), type of glaucoma, irido-corneal angle pigmentation (grade 0 to 4 according to the Scheie classification [10]) pachymetry and history of filtration surgery.

We also observed the following parameters before treatment, at the first follow up consultation and at 1 year: IOP (Goldmann Applanation Tonometer), number of topical hypotonicity-inducing molecules.

When OCT imaging was performed, Retinal Nerve Fiber Layer (RNFL) and macular ganglion cell complex thickness measurements were collected and when visual field follow-up was available, the Mean Deviation (MD) and Pattern Standard Deviation (PSD) were also recorded.

The treatment was carried out under topical anaesthesia with oxybuprocaine hydrochloride 0.4% and using a Latina contact lens or a 3-mirror lens. A SLT laser manufactured by Quantel Medical, France (Solutis laser), delivering impacts from 0.2 mJ to 2.0 mJ was used for the treatment. The energy was titrated prior to laser treatment. The first impacts on the trabeculum were performed at low energy, and the energy level was increased until a vaporization bubble formation appeared upon impact.

The treatment was then performed over 180° or 360° (at the physician's discretion), with some fifty impacts per hemi-circumference. The treatment settings used were recorded for each patient (energy level and circumference treated: 180° or 360°).

Preoperative hypotonic treatment was continued and a topical NSAID treatment was prescribed for 10 days after the laser session.

Minor and major side effects were reported.

Statistical analysis

The primary endpoint of the study was the evaluation of the pressure gain at 1 year. Treatment success was defined as a one-year decrease in pressure greater than or equal to 20% of baseline with no increase in medical treatment.

The non-parametric signed Wilcoxon test was used to compare the means, the Kruskal-Wallis test for the analysis of qualitative variables and a simple linear regression model for the quantitative variables. A p-value less than 0.05 were considered significant.

Results

We included 119 eyes of 78 patients (ethnicity: 76 Caucasian and 2 Hispanic). The clinical characteristics of the patients at baseline and the technical characteristics of the SLT laser treatment are described in Table 1 and Table 2.

The decrease in IOP at 1 year was statistically significant, with an average gain of 4.2 mmHg (SD = 5.37), i.e. an average decrease in IOP of 19.6%. The treatment success rate was 46.7% in our study, Table 3 and Table 4. The decrease in the number of hypotonicity-inducing molecules used was not significant.

The bivariate analysis of the impact of different clinical parameters on the decrease in IOP at 1 year revealed no statistical link for age, sex, side treated (left or right), pachymetry, prior filtration surgery or the number of pre-laser topical treatments. The impact of the type of glaucoma, angle pigmentation and laser energy could not be evaluated due to lack of sufficient numbers.

The only parameter having a significant impact in our study was the irido-corneal angle circumference treated: The decrease in pressure was greater when the trabeculum was treated over 180° than when it was

Table 1: Pre-laser characteristics.

	n	%/mean	SD	min	max
Number of eyes Age	119	62.0	12.0	23.0	89.0
Sex					
F	59	49.6			
M	60	50.4			
Side					
R	65	54.6			
L	54	45.4			
Open Angle Glaucoma type					
Primary	105	88.2			
Pigmentary	5	4.3			
Pseudo-exfoliative	1	0.9			
Post-traumatic or post-surgical	4	3.4			
Corticosteroid induced	4	3.4			
Pigmentation of the irido-corneal angle					
0	2	3.8			
1	11	21.2			
2	27	51.9			
3	9	17.3			
4	3	5.8			
Pachymetry		542.0 (µm)	43.7	410.0	630.0
Number of filtration surgery interventions pre-laser					
0	109	91.6			
1	7	5.9			
2	2	1.7			
3	1	0.8			
Average number of topical treatments pre-laser		2.3 (molecules)	1.0	0.0	4.0
IOP pre-laser		20.0 (mmHg)	5.0	11.0	42.0
Mean follow-up period		10.7 (months)	3.1		

Table 2: Technical characteristics of laser SLT treatment.

	n	%
Trabeculum circumference treated		
180°	24	23.3
360°	79	76.7
Laser energy (mJ)		
0.8	2	2.7
1.2	39	52.0
1.3	10	13.3
1.5	17	22.7
2	7	9.3

Table 3: IOP evolution.

	%/mean	SD
IOP pre-laser (mmHg)	**20**	5
IOP at 1 year (mmHg)	**15.3**	4.6
Decrease in IOP at 1 year (%)	**-19.6%**	22.5
Success rate	**46.7%**	

treated over 360° ($p = 0.0024$). The average gain of IOP in patients treated over 180° was 7.2 mmHg and it was 2.9 mmHg in the group treated over 360°.

In the year following the SLT, filtration surgery was required for 8 eyes.

Only two minor side effects were reported in our series, one case of visual blurring sensation and one decrease in visual acuity by pigment dispersion, occurring immediately after the laser treatment, and both resolving spontaneously.

Discussion

The place of SLT in the management of glaucoma is an additional contribution to the therapeutic arsenal since it can supplement topical drug therapy when the latter is insufficient, poorly tolerated or where self-treatment compliance is poor (problems with understanding, difficulty instilling drops, forgetting to self-treat). When performed in addition to maximal medical treatment, it also allows surgery for uncontrolled glaucoma to be delayed. It is ever more frequently proposed as a first-line treatment in newly diagnosed patients, because of its preservation of the ocular surface on the one hand and the economic gain on the other [11,12]. Katz, et al. found no difference between SLT treatment and drug treatment in the initial management of OAG [13].

Sayin, et al. report success rate of 64.5% at 1 year [14], Hodge, et al. 60% [15], Kontic, et al. 64.58% [16] and Damji, et al. 59.7% [17,18]. The success rate in our study, at 46.7%, is somewhat lower than those reported in the literature. This is probably due to our recruitment, given that we did not exclude patients in advanced stages of the disease or those with a history of filtration surgery. The various prospective and retrospective studies carried out on the efficacy of laser SLT at one year report a percentage reduction in IOP between 16.9 and 31.6% of baseline [9], consistent with our 19.6% decrease in IOP.

Table 4: Comparison of parameters pre-laser and at 1 year.

	N (number of patients with available data)	Change between T1 and T0 mean (SD)	p-value
Number of topical treatments	97	-0.11 (0.77)	0.240
IOP (mmHg)	**97**	**-4.2 (5.37)**	**< 0.0001**
MD (dB)	32	-0.54 (1.50)	0.0336
PSD (dB)	20	-0.71 (1.47)	0.0532
RNFL (µm)	48	-0.96 (2.94)	0.0176
Ganglion cell complex (µm)	9	-0.22 (1.71)	0.844

We showed no reduction in the number of topical treatments at 1 year in our study, which can also be explained by our own recruitment at the Nancy University Hospital, where patients monitored for glaucoma are often difficult to stabilise. The aim in these patients was to decrease IOP even further, in order to preserve visual function. The initial medical treatment was continued after SLT in all of these patients. Moreover, the short duration of follow up did not make it possible to demonstrate whether one or more molecules were discontinued some time after laser treatment. In a 12-year post-laser retrospective analysis of 28 patients, Giocanti, et al. reported a reduction in the use of topical treatment in 58.4% of patients [2]. In another randomised prospective study comparing medical treatment alone and laser SLT as adjuvant therapy, Lee, et al. demonstrated that the SLT-treated group required significantly fewer topical treatments than before their laser treatment [19].

We found a significant difference between the treatment circumference and the decrease in IOP at 1 year. Patients treated over 180° had a greater decrease in pressure than patients treated over 360°. This surprising difference would probably not have been found in a larger sample. Goyal, et al. [20] and Nagar, et al. [21] found no difference between the two treatment circumferences at 1 month and 12 months. In a retrospective study of 35 eyes, Shibata, et al. found greater efficacy when treating the trabeculum over its full circumference [22].

In terms of visual field and OCT parameters, relative stability is observed with minimal degradation of MD and RNFL in patients with chronic pathologies. The one-year follow up time is too short to draw any definitive conclusions.

In the literature, other factors seem to have an impact on the efficacy of selective trabeculoplasty, but were not observed in our study due to its lack of statistical power for measures of pre-laser IOP [23-27], age [27], use of a prostaglandin before SLT (which may be a factor for lower efficacy) [26] or treatment energy levels [27,28]. Lee, et al. has also evaluated optimal total treatment energy, at 226.1 mJ [29].

Our study strengthens the interest of the use of this recent treatment in the management of glaucoma patients in an ophthalmology department, as long as the iridocorneal angle allows sufficient access to the trabeculum, and this regardless of the stage of the pathology.

In conclusion, SLT is a safe and effective technique for reducing IOP. Applicable at any time in the development of the disease, its place in the therapeutic arsenal for treating open-angle glaucoma is justified. Due to the depletion of the hypotonic effect over time, it may be interesting to study the evolution of IOP in the longer term and on a larger number of patients, as well as the efficacy of retreatment.

References

1. Wise JB, Witter SL (1979) Argon laser therapy for open-angle glaucoma. A pilot study. Arch Ophthalmol 97: 319-322.
2. Giocanti-Aurégan A, Abitbol O, Bensmail D, Bensaid A, Lachkar Y (2014) Selective Laser Trabeculoplasty in the treatment of chronic open-angle glaucoma: Retrospective analysis 12 years after treatment in a cohort of 28 patients. J Fr Ophtalmol Dec 37: 812-817.
3. Alon S (2013) Selective Laser Trabeculoplasty: A Clinical Review. J Curr Glaucoma Pract 7: 58-65.
4. Latina MA, Park C (1995) Selective targeting of trabecular meshwork cells: in vitro studies of pulsed and CW laser interactions. Exp Eye Res 60: 359-371.
5. Latina MA, Sibayan SA, Shin DH, Noecker RJ, Marcellino G (1998) Q-switched 532-nm Nd:YAG laser trabeculoplasty (selective laser trabeculoplasty): a multicenter, pilot, clinical study. Ophthalmology 105: 2082-2088.
6. Samples JR, Singh K, Lin SC, Francis BA, Hodapp E, et al. (2011) Laser trabeculoplasty for open-angle glaucoma: a report by the american academy of ophthalmology. Ophthalmology 118: 2296-2302.
7. Nordmann JP (2008) The place of SLT in managing glaucoma. J Fr Ophtalmol 31: 2S69-2S73.
8. Latina MA, de Leon JM (2005) Selective laser trabeculoplasty. Ophthalmol Clin North Am 18: 409-419.
9. Wong MO, Lee JW, Choy BN, Chan JC, Lai JS (2015) Systematic review and meta-analysis on the efficacy of selective laser trabeculoplasty in open-angle glaucoma. Surv Ophthalmol 60: 36-50.
10. Scheie HG (1957) Width and pigmentation of the angle of the anterior chamber; a system of grading by gonioscopy. AMA Arch Ophthalmol 58: 510-512.
11. Seider MI, Keenan JD, Han Y (2012) Cost of selective laser trabeculoplasty vs topical medications for glaucoma. Arch Ophthalmol 130: 529-530.
12. Lee R, Hutnik CM (2006) Projected cost comparison of selective laser trabeculoplasty versus glaucoma medication

in the Ontario Health Insurance Plan. Can J Ophthalmol 41: 449-456.

13. Katz LJ, Steinmann WC, Kabir A, Molineaux J, Wizov SS, et al. (2012) Selective laser trabeculoplasty versus medical therapy as initial treatment of glaucoma: A prospective, randomized trial. J Glaucoma 21: 460-468.

14. Sayin N, Alkin Z, Ozkaya A, Demir A, Yazici AT, et al. (2013) Efficacy of selective laser trabeculoplasty in medically uncontrolled glaucoma. ISRN Ophthalmol 2013: 975281.

15. Hodge WG, Damji KF, Rock W, Buhrmann R, Bovell AM, et al. (2005) Baseline IOP predicts selective laser trabeculoplasty success at 1-year post-treatment: results from a randomised clinical trial. Br J Ophthalmol 89: 1157-1160.

16. Kontić M, Ristić D, Vukosavljević M (2014) Hypotensive effect of selective laser trabeculoplasty in patients with medically uncontrolled primary open-angle glaucoma. Srp Arh Celok Lek 142: 524-528.

17. Damji KF, Bovell AM, Hodge WG, Rock W, Shah K, et al. (2006) Selective laser trabeculoplasty versus argon laser trabeculoplasty: results from a 1-year randomised clinical trial. Br J Ophthalmol 90: 1490-1494.

18. Barkana Y, Belkin M (2007) Selective laser trabeculoplasty. Surv Ophthalmol 52: 634-654.

19. Lee JW, Chan CW, Wong MO, Chan JCh, Li Q, et al. (2014) A randomized control trial to evaluate the effect of adjuvant selective laser trabeculoplasty versus medication alone in primary open-angle glaucoma: preliminary results. Clin Ophthalmol 8: 1987-1992.

20. Goyal S, Beltran-Agullo L, Rashid S, Shah SP, Nath R, et al. (2010) Effect of primary selective laser trabeculoplasty on tonographic outflow facility: a randomised clinical trial. Br J Ophthalmol 94: 1443-1447.

21. Nagar M, Ogunyomade A, O'Brart DP, Howes F, Marshall J (2005) A randomised, prospective study comparing selective laser trabeculoplasty with latanoprost for the control of intraocular pressure in ocular hypertension and open angle glaucoma. Br J Ophthalmol 89: 1413-1417.

22. Shibata M, Sugiyama T, Ishida O, Ueki M, Kojima S, et al. (2012) Clinical results of selective laser trabeculoplasty in open-angle glaucoma in Japanese eyes: comparison of 180 degree with 360 degree SLT. J Glaucoma 21: 17-21.

23. Miki A, Kawashima R, Usui S, Matsushita K, Nishida K (2016) Treatment Outcomes and Prognostic Factors of Selective Laser Trabeculoplasty for Open-angle Glaucoma Receiving Maximal-tolerable Medical Therapy. J Glaucoma 25: 785-789.

24. Pillunat KR, Spoerl E, Elfes G, Pillunat LE (2016) Preoperative intraocular pressure as a predictor of selective laser trabeculoplasty efficacy. Acta Ophthalmol (Copenh) 94: 692-696.

25. Lee JW, Liu CC, Chan JCh, Wong RL, Wong IY, et al. (2014) Predictors of success in selective laser trabeculoplasty for primary open angle glaucoma in Chinese. Clin Ophthalmol 8: 1787-1791.

26. Bruen R, Lesk MR, Harasymowycz P (2012) Baseline Factors Predictive of SLT Response: A Prospective Study. J Ophthalmol 2012: 642869.

27. Ayala M, Chen E (2011) Predictive factors of success in selective laser trabeculoplasty (SLT) treatment. Clin Ophthalmol 5: 573-576.

28. Habib L, Lin J, Berezina T, Holland B, Fechtner RD, et al. (2013) Selective laser trabeculoplasty: Does energy dosage predict response? Oman J Ophthalmol 6: 92-95.

29. Lee JW, Wong MO, Liu CC, Lai JS (2015) Optimal selective laser trabeculoplasty energy for maximal intraocular pressure reduction in open-angle glaucoma. J Glaucoma 24: e128-e131.