

ABSTRACT

Purpose. ALT is widely used to control intraocular pressure (IOP) in glaucoma. We wished to determine predictive factors for long term success of ALT performed by supervised residents in training on patients at a local VA Hospital in Dallas.

Methods. Charts of patients with primary open angle glaucoma who underwent ALT between 2001 and 2011 were reviewed retrospectively. Those with follow up < 3 months, prior ALT/SLT, filtering procedure or inadequate data were excluded. The dependent variable was time to failure after ALT. Failure was defined as any additional medication, ALT/SLT or glaucoma filtering surgery. All patients were treated with 360° ALT. Logistic regression and receiver operating characteristic (ROC) analysis was performed to assess correlation between time to failure after ALT and age, pre-op IOP, C/D ratio, visual field defect, family history, refractive error, hypertension, diabetes, number of medications, laser energy, central corneal thickness.

Results. Evaluable data was obtained on 206 patients; mean age 65, 98% male, and 61% black. 40.8% (84/206) were classified as ALT failures. Failure and non-failure patients had equal follow-up duration of median 2 yr. Pre-ALT LogMar (mean (SD) 0.25 (.3) vs. 0.35 (.3)), no. of glaucoma medications (2.9 (1.0) vs. 3.3 (1.0)), and myopia (46% vs. 61%) differed, respectively, between ALT failures and non-failures (p<0.05). In multivariable logistic regression models, after adjusting for age, hypertension, and diabetes, we found that myopia was protective (odds ratio (OR) =0.39, 95% CI 0.21-0.78, p=0.005) but that higher laser energy ((OR=1.6 for a 20k increase in energy, 95% CI: 1.1-2.4, p=0.005) was associated with increased risk associated for ALT failure; model ROC AUC = 0.70 (95% CI: 0.63-0.78).

Conclusions. Our VA patients were mainly males but had good ethnical diversity. Better response in myopia may be related to thickness of trabecular meshwork while poorer response to increased laser energy may be from thermal damage. Patients using more than three meds were on systemic carbonic anhydrase inhibitors. ALT results were better in patients who used more than 3 meds, were myopic and required less laser energy.

INTRODUCTION

Glaucoma is a common cause of blindness and is considered to be a multifactorial progressive optic neuropathy with both ocular and systemic risk factors resulting in visual field (VF) loss. The most common variant, primary open angle glaucoma (POAG), has been widely treated using argon laser trabeculoplasty (ALT) to control intraocular pressure (IOP), a major risk factor in the progression of glaucoma. Utilizing focused thermal energy, ALT alters the trabecular meshwork thus augmenting aqueous humour drainage and lowering IOP.

Several studies have evaluated IOP control after ALT. The most prevalent predictor of post-op IOP reduction has been a direct relationship to the pre-op IOP, with a higher post-op reduction correlated with a higher pre-op IOP^{1,2}. The Early Manifest Glaucoma Trial found that the presence of bilateral disease, pseudoexfoliation, older age, cardiovascular disease, low systolic blood pressure, and thinner central corneal thickness (CCT) markedly influenced the overall progression of glaucoma³. In addition, only a handful studies have evaluated results of ALT performed by residents in teaching institutions.

The main aim of this chart review study was to evaluate predictive factors; both systemic (age, family history of glaucoma, presence of hypertension or diabetes) and ocular (CCT, refractive error, number of glaucoma medications, pre-op IOP, c/d ratio, VF defect and laser energy used, that influence the long term success of ALT when performed by residents-in-training at the Dallas VA Hospital.

PATIENTS AND METHODS

The computerized data base at the VA Hospital in Dallas was searched for diagnoses of Argon Laser trabeculoplasty surgery in primary open angle glaucoma from January 2001 till January 2011. We obtained approval for our protocol from the institutional Review Board of the VA Hospital Dallas. The protocol was also in compliance with the Health Insurance Portability and Accountability Act.

A retrospective chart review of 206 eligible VA patients with the diagnosis of POAG who underwent 360° ALT performed by supervised residents-in-training was completed. Patients with bilateral ALT had a single eye chosen at random. Patients with follow up < 3 months, prior ALT/SLT, filtering procedure or inadequate data were excluded. The dependent variable analyzed was time to failure post-ALT, with failure defined as any addition of medication, repeat ALT/SLT, or additional glaucoma filtering surgery. Logistic regression and receiver operating characteristic (ROC) analysis was performed to assess correlation between time to failure post-ALT and race, gender, age, pre-op IOP, C/D ratio, visual field defect, family history, refractive error, best corrected vision, hypertension, diabetes, number of medications, laser energy and central corneal thickness.

VF defects were measured with Humphrey 30-2 perimetry. A mild defect was defined as a mean deviation defect of less than -6dB, moderate defect between -6dB and -12dB, and severe defect above -12dB. Refractive error either myopia or hyperopia was categorized as a mild error when the refraction was less than +/- 2D, moderate error when between +/- 2D and +/- 3D, and severe error when the refraction was greater than +/- 3D. The best corrected vision was converted to Log Mar units.

Argon laser trabeculoplasty (ALT): Predictors of failure

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RESULTS

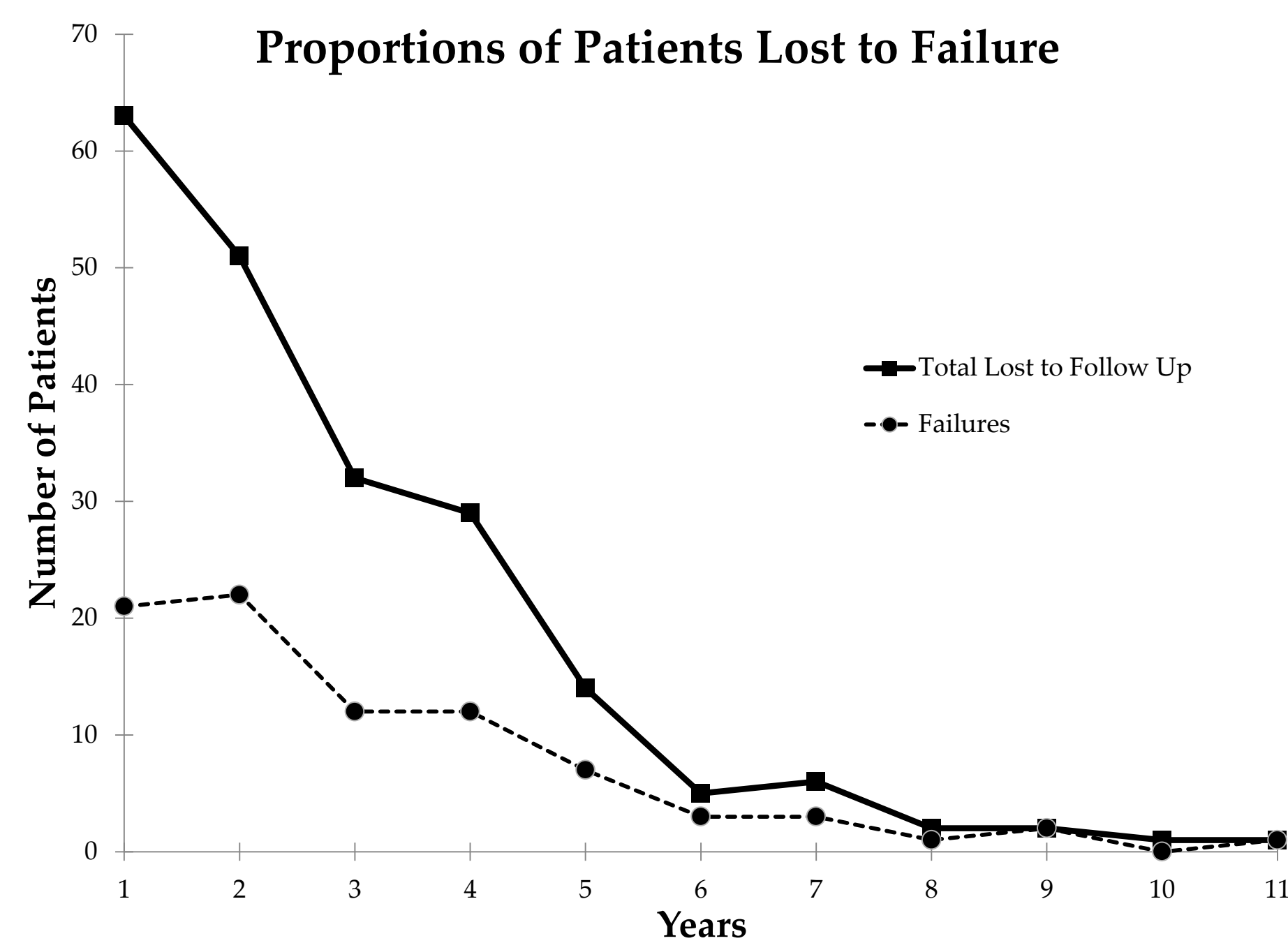


Figure 1. Proportion of patients lost to follow up due to failure. Data demonstrates a third of the total number of patients lost result from failures during the first 4 years, increasing to half at 5 years and beyond with a mean time to failure of 37.1 months.

	All subjects n=206	Non-Failures n=122	Failures n=84
Age, yrs	65.5	66.0	64.8
Female, n (%)	4 (2%)	4 (100%)	0 (0%)
Male, n (%)	202 (98%)	118 (58%)	84 (42%)
Race/Ethnicity, n (%)			
White	68 (33%)	39 (57%)	29 (43%)
Black	126 (61%)	75 (60%)	51 (40%)
Hispanic/Latino	12 (6%)	8 (67%)	4 (33%)
Family history of glaucoma	65 (32%)	39 (60%)	26 (40%)
Hypertension	159 (77%)	97 (61%)	62 (39%)
Diabetes	89 (43%)	54 (61%)	35 (39%)
Refractive error, mean value			
Myopia	1.11	1.29	0.85
Hyperopia	0.49	0.39	0.64
Visual field defect, mean value	2.11	2.09	2.14
Log Mar	0.31	0.35	0.25
IOP, mmHg	20.1	19.8	20.4
CD ratio	0.76	0.75	0.77
CCT, μ	524	528	518
ALT energy, joules	67,250	64,445	71,305
Number of glaucoma medications	3.1	3.3	2.9

Table 1. Patient demographics and data. Compiled statistics summarizing patient demographics and pertinent factors that may impact ALT results. A greater number of glaucoma medications, myopia, and a lesser laser energy used were found to significantly decrease the risk for failure post-ALT.

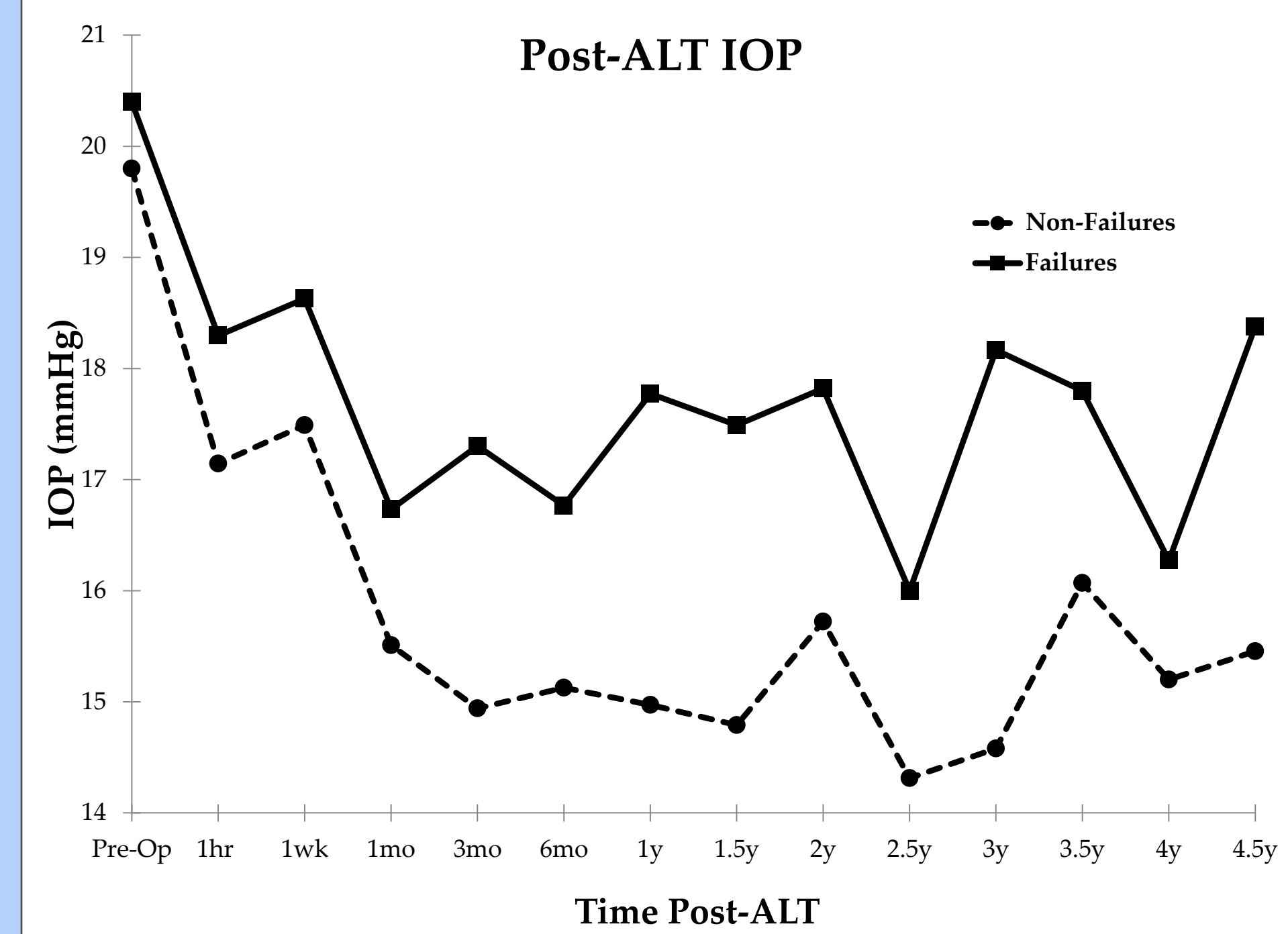


Figure 2. Non-failure and failure IOP analysis. Data trends indicate the non-failure population have universally lower IOP readings compared to failed ALT patients.

Evaluable data was obtained on 206 patients with a mean age of 65, 98% male, 61% black and 33% white. 40.8% (84/206) were classified as ALT failures (Table 1). Failure and non-failure patients had equal follow-up duration with a median of 2 years. Pre-ALT Log Mar (mean (SD) 0.25 (.3) vs. 0.35 (.3)), no. of glaucoma medications (2.9 (1.0) vs. 3.3 (1.0)), and myopia (46% vs. 61%) significantly differed, respectively, between ALT failures and non-failures (p<0.05). In multivariable logistic regression models, after adjusting for age, hypertension, and diabetes, we found that myopia was protective (odds ratio (OR) =0.39, 95% CI 0.21-0.78, p=0.005) but that higher laser energy ((OR=1.6 for a 20k increase in energy, 95% CI: 1.1-2.4, p=0.005) was associated with increased risk associated for ALT failure; model ROC AUC = 0.70 (95% CI: 0.63-0.78).

The rate of failure in comparison to the total number of patients lost to follow-up is visualized in Figure 1. The mean time to failure was 37.1, with the rate of failure for the first 2 years at 10% per year, dropping to 5% for the next 2 years and steadily decreasing in proportion to the number of patients lost to follow up.

IOP analysis (Figure 2) demonstrates a mean post-ALT IOP of 17.5 mmHg throughout the first 5 years of follow up for failures and 15.5 mmHg for non-failures. The largest drop in IOP for both failures and non-failures occurs within the first month and is relatively maintained in both populations.



CONCLUSIONS

The rate of failure indicates that results of ALT performed by residents-in training in US veterans with primary open angle glaucoma are comparable with other published data^{4,5}. Although the rate is slightly lower (initially 10% vs. 19%), this is probably a function of the number of patients lost to follow up.

Less failures post-ALT were observed in patients who were myopic, used more than three medications pre-op, and who required less laser energy during surgery. The pathophysiological mechanism of the myopic response may be related to the thickness of trabecular meshwork, while poorer response to increased laser energy may stem from excessive thermal damage. Patients using more than three meds were all on systemic carbonic anhydrase inhibitors, which may extend a protective effect.

Similar to other studies, our data indicates that ALT is an effective mode of treatment in patients with primary open angle glaucoma but the long term outcomes are guarded because of the progressive nature of the disease⁵. In addition, EMGT data analysis found correlation between age, vascular disease and thin CCT with the progression of glaucoma, with ALT halving the risk of progression³. However, our results indicate that the outcome of ALT may also be dependent on a new set of patient characteristics, connoting an intricate interplay of factors influencing the pathogenesis of glaucoma, which hopefully may provide a framework for the development of positive predictive factors for ALT prognosis.

LITERATURE CITED

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