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## Argon Laser Trabeculoplasty: A 10-Year Follow-Up

### Abstract

To determine the current place of argon laser trabeculoplasty (ALT) in the therapeutic armamentarium of primary open-angle glaucoma (POAG), 211 photocoagulated phakic eyes were analyzed. 159 eyes had a 5-year follow-up, 147 eyes had an 8-year follow-up and 127 eyes had a minimal 10-year follow-up. These eyes came from an initial group of 151 patients, 76 women and 75 men, with a mean age of 67 years. We decided, to judge trabeculoplasty results according to three combined criteria of failure – insufficient or transient intraocular pressure drop ( $\leq 3$  mm Hg), progression in visual field loss and need for filtering surgery – and according to various expected goals: prevent an increase of drugs with their subsequent side effects, taper a nontolerated medical treatment, and try to cease all medical treatment in noncompliant patients. According to these criteria, during the first 5 years, the cumulative failure rate in the 159 eyes rose steadily from 19% (31 eyes) in the 1st year to 52% (82 eyes) in the 5th year. In the 147 eyes with an 8-year follow-up, 25 eyes (17%) were successful and in the 127 eyes with a 10-year follow-up 14 eyes (11%) were still controlled. At the 10-year follow-up the surgical failure rate (35%; 40 eyes in 113) was similar to the rate at 5 years (33%; 27 in 82). 30 eyes, which were excluded from the study, despite being still controlled, belonged to patients who had died during the follow-up. Their mean age at the time of ALT was 76 years. The low success rate at 10 years was predictable from the 10% new failure cases per year encountered in the 5-year data. Despite this important failure rate in long-term treatment, making laser efficiency comparable with drugs, trabeculoplasty is still useful in the current therapeutic armamentarium of POAG; not as a rival procedure of invasive filtering operation reserved to presurgical glaucomas, but as a complementary treatment of the intermediate stages of the disease for which efficacy was found to be better in the current study and for older patients with a short life expectancy.

### Key Words

Primary open-angle glaucoma  
Argon laser  
Trabeculoplasty

### Introduction

Since the preliminary report of Wise and Witter [42] trabecular argon laser photocoagulation, called trabeculoretraction (TRLA) in the French literature [8, 12, 15, 20] and argon

laser trabeculoplasty (ALT) in the English literature [35], has become a real therapeutic aid universally accepted and used. This paper reports the 10-year follow-up of an initial group of 211 consecutive phakic eyes with primary open-angle glaucoma (POAG) treated with ALT.

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## Subjects and Method

### Subjects

Since September 1981, 927 eyes (872 phakic and 55 aphakic) have been treated with ALT by one of us (F.M.). The first 211 consecutive phakic eyes with POAG (other forms of chronic open-angle glaucoma were excluded i.e. pseudo-capsular glaucoma, pigmentary glaucoma and low-tension glaucoma), a report on which was previously published with a 1-year follow-up [11], were studied again after 10 years. These 211 eyes represent 151 patients: 76 women and 75 men aged between 25 and 93 with an average of 67 years. Our results from this initial population were also analyzed including a 2-year [16], a 4-year [13, 22], a 5-year [19] and an 8-year follow-up [23] on a decreasing number of eyes. A number of eyes were excluded because of a patient's death or noncompliance. Among the initial 211 eyes, 64 (30%) had to be excluded at 8 years and 84 (40%) at 10 years.

### Method

Our laser technique and postlaser regimen have been described in previous publications [8, 12, 17, 18, 20]. We would like to point out that, in all cases, ALT is now performed in two sessions separated by a 1-month interval. Each session consists of 50 burns applied at an angle of 180°. In most of the cases included in this study, ALT was performed in one session using 100 burns applied at 360°.

## Results

### Criteria of Failure

In the literature, criteria of failure are rather different. We decided to judge ALT results according to three combined criteria of failure – insufficient or transient intraocular pressure drop ( $\leq 3$  mm Hg), progression in visual field loss and need for a filtering surgery – and, also, according to various expected goals: prevent an increase of drugs with their subsequent side effects, taper a nontolerated medical treatment, and try to cease all medical treatment in noncompliant patients.

### Our Previous Results

According to our criteria of failure, in 159 eyes followed for 5 years, among the initial 211 phakic POAG [19], 82 eyes (52%) were failures and 77 eyes (48%) were successful. In the 77 successes the mean intraocular pressure (IOP) drop was 6.57 mm Hg and the initial medical treatment remained the same in 44 cases (57%) and was tapered or stopped in 33 eyes (43%). Of the 82 failures, 55 (67%) could be managed for various reasons without trabeculectomy, but 27 cases (33% of all failures and 17% of the entire study) needed filtration surgery to stop the disease evolution. Among the 147 eyes followed for 8 years [23], 122 eyes (83%) were failures and only 25 (17%) were still controlled.

### Our 10-Year Results

In the 127 eyes followed for 10 years, just 14 (11%) were successes. Their mean IOP drop was 5.5 mm Hg, inferior to the mean IOP drop of the 77 successes at 5 years (6.57 mm Hg). Of the 113 failures at 10 years, 40 (35%) needed a trabeculectomy, in the other cases, either surgical filtration was not possible, or failure could be managed by increasing initial medical treatment. The surgical failure rate at 10 years (35%) was similar to that at 5 years (33%: 27 operated eyes upon 82 failures). At 10 years, among the 84 excluded eyes, 30 still controlled (14% of the initial 211 eyes) belonged to patients who had died during the follow-up. Their average age at the time of ALT was 76 years.

## Discussion

In this retrospective study a great number of eyes were excluded. The explanation lies in our referral population (people often coming from a long distance) and in the elevated average age of patients at the time of laser treat-

ment. This drawback seems usual for long-term studies of such a chronic and progressive disease in old people. Demailly [2] after a 6-year follow-up of an initial POAG population could study only 54% of the patients. In spite of this drawback an retrospective analysis of ALT efficacy at 10 years is still valid in order to determine its current place in the therapeutic armamentarium of POAG.

### *Efficiency of ALT*

The results of this 10-year follow-up study show a gradual increase of the cumulative failure rate from 19% at 1 year to 30% at 2 years, 41% at 3 years, 48% at 4 years, 52% at 5 years, 83% at 8 years and finally 89% at 10 years. If we consider the remaining successful cases in each follow-up year, the rate of new failures per year can be calculated. It was found to be about 10% per year in our 5-year study [19], anticipating a maximal theoretical efficiency not exceeding 10 years. During the 10-year follow-up this trend was confirmed but not totally, since 11% of the eyes were still controlled although no success could be anticipated.

In the literature at the time of our manuscript submission three publications had the same follow-up, Wise [41]; Ticho and Neshor [34], and Spaeth and Baez [32]. Two papers had better results than our study. Wise [41] had 26 successes (54%) among 48 eyes followed for 8 years and Ticho and Neshor [34] had 18 controlled eyes (56%) in 32 eyes followed for 8 years and 8 successes (57%) among 14 cases with a 10-year follow-up. But their criteria of failure were only a final IOP  $\geq 21$  mm Hg and operated eyes, without considering the expected goals for the stage of POAG when ALT was done (i.e., prevent an increase of drugs, taper a nontolerated medical treatment or even try to cease all medication in noncompliant patients). Our criteria for success were less liberal and probably ex-

plain our low success rate at 10 years. But these strict criteria seemed to us more appropriate to appreciate the place of ALT in the long-term management of POAG. Also our surgical failure rate, very close at 5 years (33%) and 10 years (35%), and therefore consistent with our indications not being limited to those patients needing surgery, illustrates very well our need to judge ALT failure not only from the operated eyes. On the other hand the paper of Spaeth and Baez [32] displayed data very close to ours. Their success rate of 5 years was 35%, at 8 years 26% and at 10 years 5% with a failure rate of approximately 8% per year.

The more numerous publications with a 5-year follow-up [26, 29, 31, 33, 36, 41] had previously shown a regular increase in their failure rate. Even the paper of Fink et al. [5] presented more failures (55%) than successes at 3 years. At 5 years our failure rate of approximately 50% [19] was consistent with the results in the literature with the same follow-up and the same criteria of failure [26, 29, 31, 33, 36, 41]. Only Demailly [2] had a failure rate of 14% but with surgical criteria of failure; our study at 5 years [19] according to the same criteria had 17% failure. As early as 1987 our results at 4 years [13, 22] enabled us to calculate, by means of a life table method, a success rate of only 50% at 5 years and not far from nil at 10 years. So the low success rate at 10 years (11%) of the present study was already anticipated and led us, by this time, to question the usefulness of ALT [13, 22]. Despite our results at 10 years consistent without our previous publications [13, 16, 22], we think that ALT retains a place in the current therapeutic regimen of POAG for the following reasons.

### *Use of ALT*

First of all, ALT is a simple outpatient procedure performed under a topical anesthetic and its complication rate is relatively low, par-

ticularly when performed in two separate sessions [8, 12, 17, 18]. Secondly, its efficiency is better for patients over 55–65 years old [6, 11, 14, 19, 27, 28, 35, 41] in whom the risk of cataract after trabeculectomy increases [1, 2]. Further, ALT results can be considered useful at 5 years for moderate stages of POAG [2, 5, 19, 41] and for older patients with a short life expectancy as shown by the mean age (76 years) at the time of ALT of patients still controlled, who had died during the follow-up of the 10-year study. At last, we would like to recall that one of the presumed mechanisms of action of ALT is comparable to myotics [40, 42]. For all these reasons ALT can be considered as the equivalent of a medical treatment and its success rate, particularly the one of our 5-year study (48%) [19], is comparable to drugs.

Indeed Watson [37] found that only 36% of a glaucomatous population could be controlled for 5 years on a medical regimen of timolol 0.5% twice a day and pilocarpine 2% 3 times a day. Moreover the Glaucoma Laser Trial study [7], comparing initial treatment of POAG by means of ALT vs. timolol 0.5% b.i.d, displayed a 44% success rate for ALT at 2 years and only a 30% success rate for the beta-adrenergic blocker. These results did not lead the authors to stop using beta-adrenergic blockers in the treatment of PAOG. Wise [41], in spite of better results at 10 years than in our study, already in 1987 considered ALT as a medical treatment according to its risk factors of failure: younger patients, a very high IOP with medical treatment and clinical forms of chronic open-angle glaucoma. He suggested using ALT in the moderate stages of the disease for very compliant patients over 60 years; for the other cases he preferred surgery. Therefore ALT retains a place in the therapeutic armamentarium of PAOG but not as a rival procedure of invasive filtering operation reserved to presurgical glaucomas, but as a complementary treatment of the interme-

diate stages of the disease, initially powerful but with a decreasing efficacy over time as encountered with drugs.

In a chronic and progressive disease such as POAG, whatever the treatment, late failures are predictable. So, even if a procedure is only temporarily efficient in stopping or slowing down the severity curve of this disease, its usefulness is far from negligible. This position called 'the least risky strategy', according to Demailly [2], is confirmed by numerous authors. But is it wise in the long run? Is there no risk in delaying an operation? Moreover, cannot ALT alter the efficacy of a subsequent filtration surgery?

#### *Drawbacks of ALT*

Some investigators claimed that surgery after ALT failure had less good results without being able to state whether laser treatment or prolonged drugs therapy produced a more deleterious effect on conjunctival tissue [4, 10, 24, 25, 30]. We agree with Demailly et al. [3], who have found no differences in the results of trabeculectomy between eyes treated previously with laser or not, except when the operation was carried out during the first 3 months. What about delaying surgery after using maximal tolerated medical treatment and ALT? According to some British authors [9, 30, 37, 38], there is a current trend to operate sooner. Theoretically it would be the best management if we could be sure of a 100% success rate without any complications such as lens opacification. Unfortunately this is not yet the case, especially for glaucoma patients over 60 years, in which ALT is most efficient.

Indeed, according to Demailly [2], for these patients the cataractogenous risk at 5 years after surgery is 46%. Further, during the 1st postsurgical year a central visual acuity loss of three lines is encountered. Moreover at 5 years the IOP drop is only 5 mm Hg and in half of the cases a complementary medical

treatment is mandatory. Many authors have found a stabilization of the visual field in only 30–60% of the cases after a successful pressure decreasing filtration surgery. The rationale is the lack of a strong relationship between level of IOP and/or its decrease and aggravation of the glaucomatous optic nerve head abnormalities [38, 39]. More recently, Akafo et al. [1] presented their results of trabeculectomy with a 10-year follow-up. Their success rate was only 67% and 5 years after surgery 22% of the eyes needed a cataract operation. Moreover, there was a 5% rate of endophthalmitis. As for the successful IOP decrease in operated eyes, visual field deterioration continued in 37% of the cases. Therefore, it is not yet positively proven that early surgery in the course of POAG is the best treatment modality. More prospective studies are mandatory to confirm this trend [2].

## Conclusion

One can imagine and hope that, close to the beginning of the 21st century, genetical engineering therapy and new drugs able to re-

store optic nerve fibers will make our discussion about the best choice of a therapeutic regimen in POAG obsolete. In the meantime, it seems advisable to choose, for the moderate and intermediate stages of POAG and in older patients with a short life expectancy, a less risky treatment equivalent to drugs which makes it possible to postpone surgery for many years without complications and altering filtration efficacy when it becomes mandatory. During the past 10 years, ALT has been for us a very interesting experience, full of learning, useful for patients, and causative of stimulating thoughts about the treatment of POAG. The fact that all the treatments have been carried out by the same physician (F.M.) reinforces the homogeneity and validity of the displayed data. We consider the results of our 10-year follow-up study decisive to assess the existence of a regularly linear decreasing efficacy of ALT and therefore its likelihood to be valid on a biological ground. At the present time we still ignore how efficient ALT will be in an individual patient. What we are currently able to predict, on a statistical basis, is the long-term (10 years) effect of trabeculoplasty according to a patient's age and POAG stage.

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