

SCIENTIFIC CORRESPONDENCE

Role of argon laser trabeculoplasty as primary and secondary therapy in open angle glaucoma in Indian patients

H C Agarwal, R Sihota, C Das, T Dada

Br J Ophthalmol 2002;**86**:733–736

Aims: To study the efficacy of argon laser trabeculoplasty (ALT) as a primary and secondary therapy in Indian patients with primary open angle glaucoma (POAG).

Methods: ALT was performed as a primary therapy in 40 eyes of 21 patients newly diagnosed with POAG (group I) and as a secondary therapy in 39 eyes of 21 patients who had been taking topical antiglaucoma medications for more than 1 year. The best corrected visual acuity, baseline intraocular pressure (IOP), diurnal variation of IOP, anterior chamber angles, and visual fields were the various parameters evaluated before and after performing ALT. Follow up visits were scheduled at 24 hours, 1 week, 1 month, 3 months, 6 months, and 1 year after the surgery. The patients were recalled at the end of 5 years for the final follow up examination. Success of ALT was defined as IOP \leq 21 mm Hg without any medication with no progression of disc or visual field changes.

Results: The pre-laser mean IOP was 25.8 (SD 3.4) mm Hg in group I and 26.1 (3.2) mm Hg in group II. The mean post-laser IOP at 5 year follow up was 18.1 (3.2) mm Hg in group I and 22.7 (3.9) mm Hg in group II ($p=0.002$) while the mean reduction in IOP was 5.7 (1.8) mm Hg in group I and 3.2 (0.8) mm Hg in group II ($p<0.001$). The diurnal variation reduced from a preoperative value of 7.9 (1.4) mm Hg to 3.6 (1.3) mm Hg in group I and from 7.7 (1.4) mm Hg to 5.8 (1.8) mm Hg in group II ($p<0.001$). The success rate of ALT was 75% at 1 year and 65% at 5 years in group I and 35% at 1 year and 10% at 5 years in group II.

Conclusion: ALT can be used as a primary therapy in pigmented eyes with POAG. ALT is less effective as a secondary therapy in controlling the IOP in eyes of patients on long term topical antiglaucoma treatment.

The initial treatment of primary open angle glaucoma (POAG) has been the reduction of intraocular pressure (IOP), by using topical medications. If medical therapy fails, then the patient is generally subjected to surgery. The introduction of argon laser trabeculoplasty (ALT) enabled glaucoma specialists to interpose an intermediate treatment between medical therapy and surgery to lower the IOP and postpone/obviate the need for filtering surgery. Several investigators have shown that ALT as a primary treatment may be more efficacious than topical antiglaucoma therapy in reducing the IOP and may help glaucoma patients enjoy a better quality of life by reducing the inconvenience and side effects of ocular hypotensive medications.^{1–3}

Although the efficacy of ALT has been established in white populations,^{4–8} there are very few studies to suggest the role of ALT as a primary therapy for eyes with dark brown irides.⁹ In the present study, we evaluated the role of ALT as a primary

therapy and also as an adjunctive secondary procedure in POAG patients on topical antiglaucoma medications.

MATERIAL AND METHODS

Consecutive patients definitively diagnosed to have POAG at the glaucoma service were enrolled for the study over a period of 6 months. The criteria for patient selection were age \geq 50 years, phakic eyes, cup:disc ratio of 0.5 or more, polar notching or narrowing of the neuroretinal rim, and asymmetry of cup:disc ratio of >0.2 between the two eyes, glaucomatous visual field defect, open angles on gonioscopy, basal IOP >21 mm Hg, and a best corrected visual acuity of more than 20/80.

The exclusion criteria were eyes with an IOP >45 mm Hg, evidence of any ocular pathology other than glaucoma, previous corneal, intraocular, or laser surgery, and patients with only one eye.

The patients were allocated into two groups based on their previous antiglaucoma treatment:

- Group I consisted of 40 eyes of 21 patients newly diagnosed with POAG who had not received any antiglaucoma medication.
- Group II consisted of 39 eyes of 21 patients who had been using antiglaucoma medication for more than 1 year.

All patients underwent a detailed examination before laser treatment. This included a record of the best corrected visual acuity, slit lamp biomicroscopy of the anterior segment of the eye, IOP measurement by Goldmann applanation tonometer, gonioscopy with the Goldmann single mirror gonioscope, fundus evaluation by direct ophthalmoscopy and 90 D lens, and visual field charting on the Humphrey automated perimeter, using the 30-2 threshold program. The diurnal variation of the IOP was recorded at 4, 7, 10 am and 1, 4, 7, 10 pm.

One tablet of acetazolamide (250 mg) was given orally to all patients, half an hour before laser therapy. The argon laser trabeculoplasty was performed using a Ritch trabeculoplasty lens; 360° of the trabecular meshwork was treated with 100 spots of 50 μ m size, 0.1 second exposure time, and 0.8–1 W laser power. The laser burns were aimed at the junction of anterior non-pigmented and posterior pigmented part of the trabecular meshwork. The power intensity was adjusted to achieve blanching. Post laser the patients received 0.1% dexamethasone four times daily and 0.5% timolol twice daily for 5 days. Follow up examinations were scheduled at 24 hours, 1 week, 1 month, 3 months, 6 months, 9 months, and 12 months after the laser therapy. The IOP, visual acuity, and fundus findings were recorded at each visit. Diurnal variation of IOP, gonioscopy, and visual field examinations were performed every 3 months until the end of the first year and on recall at 5 years.

In the eyes receiving antiglaucoma medications before ALT, the medications were tapered serially, first pilocarpine, followed by dipivefrin or β blockers at monthly intervals—that is, 1, 2, and 3 months after ALT. Each time the IOP was recorded 14–21 days after stopping the drug.

Table 1 Effect of ALT on IOP (mm Hg)

	Pre-ALT IOP	Post-ALT IOP		
		6 Months	12 Months	5 Years
Group I	25.8 (3.4)	17.8 (2.6)	18.1 (2.8)	18.1 (3.2)
Group II	26.1 (3.2)	18.8 (3.6)	21.3 (3.7)	22.7 (2.9)
p Value	0.69	0.16	0.028	0.002

Table 2 Effect of ALT on IOP reduction (mm Hg)

Mean IOP reduction	Post-ALT		
	6 Months	12 Months	5 Years
Group I	6.8 (2.6)	6.4 (2.0)	5.7 (1.8)
Group II	5.8 (3.6)	4.6 (1.2)	3.2 (0.8)
p Value	0.022	<0.001	<0.001

Table 3 Effect of ALT on diurnal variation of IOP (mm Hg)

	Pre-ALT diurnal range	Post-ALT diurnal range		
		6 Months	12 Months	5 Years
Group I	7.9 (1.4)	3.2 (1.3)	3.5 (1.2)	3.6 (1.3)
Group II	7.7 (1.4)	3.6 (1.5)	4.6 (2.0)	5.8 (1.8)
p Value	0.53	0.21	0.004	<0.001

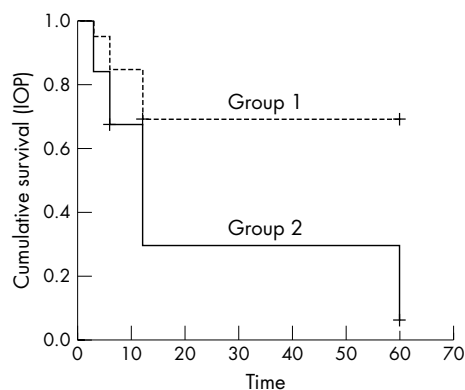
Table 4 Success rate of ALT of medication

	6 Months	12 Months	5 Years
Group I	90%	75%	65% (100%*)
Group II	67%	35%	10% (45%*)

*IOP controlled on 1 or 2 topical medications.

Success of treatment was defined in our study as an IOP ≤ 21 mm Hg without any medications with no further progression of disc and field changes.

The data were analysed using the STATA VERSION 7.0 program. Student's *t* test was applied to compare data between the two groups and the χ^2 test was used to analyse data within the

**Figure 1** Kaplan-Meier 5 year survival curve for primary and secondary ALT.

same group and in the comparison of the success rate. A p value of less than 0.5 was taken as significant. A Kaplan-Meier survival curve for IOP was obtained in the two groups studied.

RESULTS

Argon laser trabeculoplasty (ALT) was performed in 79 eyes of 42 patients with POAG in the present study. The patients were divided into two groups, ALT being performed as a primary procedure in 40 eyes in group I and as a secondary procedure in 39 eyes in group II.

There was no statistically significant difference in the demographic parameters between the two groups. Group I comprised 18 males and three females with a mean age of 58.8 (SD 6.6) years (range 51–70 years). All eyes were followed up to 1 year after ALT and 30 eyes (75%) remained for the final follow up at 5 years. The mean pre-laser IOP was 25.8 (3.4) mm Hg and the pre-laser mean diurnal variation of IOP was 7.9 (1.4) mm Hg, the mean IOP post-ALT at 3, 6, 9, 12 months, and 5 year follow up was 17.4 (2.2) mm Hg, 17.8 (2.6) mm Hg, 18.2 (3.2) mm Hg, 18.1 (2.8) mm Hg, and 18.1 (3.2) mm Hg respectively. The mean reduction in IOP was 6.4 (1.7) mm Hg, 5.8 (1.8) mm Hg, 6.7 (1.5) mm Hg, 6.4 (2.0) mm Hg, and 5.7 (1.8) mm Hg at 3, 6, 9, 12 months, and 5 years respectively. The mean diurnal variation of IOP was reduced from a preoperative value of 7.9 (1.4) mm Hg to 3.5 (1.3) mm Hg, 3.2 (1.3) mm Hg, 3.6 (1.7) mm Hg, 3.5 (1.2) mm Hg, and 3.6 (1.3) mm Hg at 3, 6, 9, 12 months, and 5 years respectively, post-ALT. At the 3 month follow up 95% of eyes were controlled (IOP ≤ 21 mm Hg) without any drug which reduced to 90% of eyes at 6 months, 75% of eyes at 12 months, and 65% of eyes at 5 year follow up. At the final follow up, the IOP was controlled in all eyes, 65% without medication, 30% on one topical medication, and 5% on two topical medications.

Complications noted were a transient post-ALT IOP spike in 18 eyes (45%), iritis and hyphaema in one eye each (2.5%).

Group II comprised 16 male and five female patients with a mean age of 57.4 (6.9) years. The pre-laser mean IOP was 26.1 (3.2) mm Hg and the mean pre-laser diurnal variation of IOP was 7.7 (1.4) mm Hg. The mean number of medications being used was 1.5, with 20 eyes receiving one drug, 17 eyes two drugs, and two eyes with a failed trabeculectomy three drugs. Post laser the mean IOP at 3, 6, 9, 12 months, and 5 year follow up was 18.1 (2.6) mm Hg, 18.8 (3.6) mm Hg, 18.5 (3.6) mm Hg, 21.3 (3.7) mm Hg, and 22.7 (2.9) mm Hg respectively. The mean reduction in IOP at these follow up visits was 6.2 (1.6) mm Hg, 5.8 (1.5) mm Hg, 5.6 (1.6) mm Hg, 4.6 (1.2) mm Hg, and 3.2 (0.8) mm Hg. The mean diurnal variation of IOP was reduced from 7.7 (1.4) mm Hg to 3.3 (2.0) mm Hg, 3.6 (1.5) mm Hg, 3.8 (1.7) mm Hg, 4.6 (2.0) mm Hg, 5.8 (1.8) mm Hg at 3, 6, 9, 12 months, and 5 year follow up. At 3 months post-ALT, the IOP was controlled without any medication in 84% of eyes, which decreased to 67% of eyes at 6 months, 35% of eyes at 12 months, and 10% of eyes at 5 years. At the final follow up at 5 years, 10% of eyes were controlled without medications, 15% were controlled on one topical medication, and 20% on two topical medications. If the IOP was more than 21 mm Hg on two topical medications then a trabeculectomy was performed and 50% of eyes underwent a trabeculectomy to control the IOP during the course of the study. Two eyes were operated within 6 months after completion of ALT, four eyes were operated between 6 months and 1 year after ALT, and 13 eyes underwent trabeculectomy between 1 and 5 years of having ALT. Out of the 20 eyes which were continued on medical treatment and did not require surgery, 14 eyes (70%) remained for calculation of average pressures at the 5 year follow up. Twenty eyes (51.3%) had a transient rise in the IOP after ALT. Two eyes (5%) developed iritis and one eye (2.5%) developed peripheral anterior synechiae.

The mean IOPs, the reduction in IOP, the diurnal variation of IOP, and the success rates of ALT were significantly better in

group I compared with group II. The mean post-laser IOP (Table 1) at 5 year follow up was 18.1 (3.2) mm Hg in group I and 22.7 (3.9) mm Hg in group II ($p=0.002$), while the mean reduction in IOP (Table 2) was 5.7 (1.8) mm Hg in group I compared with 3.2 (0.8) mm Hg in group II ($p<0.001$). The diurnal variation (Table 3) reduced from a preoperative value of 7.9 (1.4) mm Hg to 3.6 (1.3) mm Hg in group I and from 7.7 (1.4) mm Hg to 5.8 (1.8) mm Hg in group II ($p<0.001$). The success rate (Table 4) of ALT was 75% at 1 year and 65% at 5 years in group I and 35% at 1 year and 10% at 5 years in group II. With the use of one or two topical medications, the IOP was controlled in 45% of patients in group II. The 5 year Kaplan-Meier survival curve is given in Figure 1.

DISCUSSION

A number of studies have been published on the effect of ALT in eyes of white people.¹⁻⁸ However, there is a paucity of data regarding the efficacy of ALT in POAG patients with dark brown irides.⁸ There are very few studies published which compare the effect of ALT as a primary versus secondary procedure. In addition, previously conducted studies have rarely addressed the issue of the effect of primary and secondary ALT on the diurnal fluctuation of IOP.

In our study ALT as a primary therapy was successful in controlling the IOP in 65% of the patients after 5 years. It caused a mean IOP reduction of 5.7 mm Hg and reduced the diurnal variation of IOP from 7.9 mm Hg to 3.6 mm Hg at the final follow up. ALT as a secondary therapy was significantly less successful. The IOP could be controlled in only 10% of eyes at the 5 year follow up. The mean reduction in the IOP was 2.2 mm Hg and the diurnal variation of IOP reduced from 7.7 mm Hg to 5.8 mm Hg at the final follow up examination.

The Glaucoma Laser Trial (GLT)⁴ reported a reduction in the mean IOP of 9 mm Hg in eyes undergoing a primary ALT versus 7 mm Hg in eyes which were initially treated medically and then underwent ALT at a 2 year follow up. Forty four per cent of eyes were controlled after ALT alone and 70% were controlled on ALT and timolol after 2 years in the GLT. After 7 years the results of the GLT⁵ showed that the eyes that had undergone primary ALT had a 1.2 mm Hg greater reduction in IOP and a 0.6 dB greater improvement in the visual field from entry into the trial compared with the eyes initially treated with medication. The study thus concluded that ALT is as good if not better than medical therapy as the initial treatment for POAG.

Wise⁶ reported 10 year results of ALT in POAG and found that the percentage of eyes with an IOP of less than 21 mm Hg were 61% at 5 years and 70% at the end of a 10 year follow up. Odberg and Sandvik⁷ reported a mean reduction in IOP of 8.8 mm Hg, 1 month after primary ALT therapy, and a success rate without medication of 77% after 2 years, 67% after 5 years, and 67% after 8 years. Fink *et al*⁷ noted that primary ALT therapy caused a reduction in the mean IOP of 5.4 mm Hg at the 2 year follow up and the success rate was 66.7%. Bergea *et al*⁹ reported a 2 year success rate of 63% in their study on primary ALT. Sharma and Gupta¹⁰ reported the success rate of ALT as a primary treatment of POAG in Indian eyes to be 76% at 1 year and 59% at 2 years. The mean fall in IOP was 5.85 (3.46) mm Hg at the 2 year follow up and the IOP decreased from a baseline value of 25.48 (4.13) mm Hg to 18.24 mm Hg, 2 years after ALT. In our study the mean reduction in the IOP was 5.7 mm Hg at the end of a 5 year follow up after primary ALT and the success rate was 75% at 1 year and 65% at 5 years (Table 5). Our study correlates well with earlier reports in terms of the success of primary ALT and shows an additional dampening effect on the diurnal variation of IOP.

Several studies are available on the effect of ALT as a secondary treatment for patients of POAG already using topical antiglaucoma medications. Moulin *et al*¹¹ reported the results of ALT in 211 phakic eyes of POAG patients. The success

Table 5 Success rate of primary ALT

Author	Year	Success rate (%)	Follow up (years)
Wise	1987	61	5
		70	10
Fink	1988	66.7	2
GLT	1990	44	2
Bergea	1994	63	2
Sharma	1997	59	2
Odberg	1999	67	8
Present study	2001	65	5
		75	1

Table 6 Success rate of secondary ALT

Author	Year	Success rate (%)	Follow up (years)
Grinich	1987	59	3
Shingleton	1993	49	5
		32	10
Moulin	1993	48	5
		11	10
Lotti	1995	61	5
		40	10
Adachi	1994	40.3	5
		26.8	10
Ghosh	1996	9.2	4
		10	5
Present study	2001	10	5
		35	1

rate was 81% at 1 year, 48% at 5 years, and only 11% at 10 years. In a similar study Shingleton *et al*¹² reported success rates of 77% at 1 year, 49% at 5 years, and 32% at 10 years. The mean decrease in IOP was 10 (4.2) mm Hg at 5 years and 8.9 (5.2) mm Hg at 10 years. Grinich *et al*¹³ reported a mean reduction of 7.8 mm Hg in the IOP, 3 years after ALT treatment. Adachi *et al*¹⁴ reported a success rate of 40.3% at 5 years and 26.8% at 10 years after ALT therapy in the Japanese population. The success rate of ALT in the study conducted by Lotti *et al*¹⁵ was 78% at 1 year, 61% at 5 years, and 40% at 10.5 years. Ghosh *et al*¹⁶ studied the effect of ALT on Indian eyes of POAG patients who were uncontrolled on maximum tolerated medical therapy. Ninety three per cent of patients were controlled at 3 months and 72.7% at 1 year, but only 9.2% were controlled at the end of 4 years. In our study secondary ALT therapy was successful in controlling the IOP in 35% of eyes at 1 year and only 10% of eyes at 5 years (Table 6). The results of secondary ALT were very poor in our study and that of Ghosh *et al*,¹⁶ suggesting that ALT as a secondary therapy may not be suitable for a long term IOP control in pigmented eyes.

In most studies ALT has generally been performed in two sessions, 4 weeks apart, treating 180° of the trabecular meshwork at one time. It has been our experience that 180° of treatment is relatively ineffective and the entire 360° circumference of the trabecular meshwork should be treated with laser spots. Although this causes a transient rise in IOP (up to 50% of cases in our series), the IOP spike is less than 5 mm Hg and easily controlled on topical medication. The glaucoma laser trial reported a similar acute rise in the IOP with an IOP spike of more than 5 mm Hg in 34% eyes and more than 10 mm Hg in 12% patients after ALT.¹⁷

Primary ALT has a definite role in the management of POAG patients. As a first line therapy it is effective in avoiding medication and helps to reduce the number of medications and delay surgery when used as a second line therapy. Another major advantage of ALT in addition to IOP reduction is that it blunts the spikes of the diurnal variation of IOP, which may be

an important factor in preventing progression of glaucoma-optic nerve damage.

.....
Authors' affiliations

H C Agarwal, R Sihota, C Das, T Dada, Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi, India

Correspondence to: Dr Ramanjit Sihota, RP Center for Ophthalmic Sciences, All India Institute of Medical Sciences, Ansari Nagar, New Delhi 110029, India; rjsihota@hotmail.com

Accepted for publication 15 February 2002

REFERENCES

- 1 **Thomas JV**, El-Mofty A, Hamdy EE, *et al*. Argon laser trabeculoplasty as initial therapy for glaucoma. *Arch Ophthalmol* 1984;**102**:702-4.
- 2 **Wise JB**. Long term control of adult open angle glaucoma by argon laser treatment. *Ophthalmology* 1981;**88**:197-202.
- 3 **Tuulonen A**. Laser trabeculoplasty as primary therapy in chronic open angle glaucoma. *Acta Ophthalmol* 1984;**62**:150-5.
- 4 **The Glaucoma Laser Trial Research Group**. The Glaucoma Laser Trial (GLT). Results of argon laser trabeculoplasty versus topical medications. *Ophthalmology* 1997;**97**:1403-13.
- 5 **Glaucoma Laser Trial Research Group**. The Glaucoma Laser Trial (GLT) and glaucoma laser trial follow up study. 7. Results. *Am J Ophthalmol* 1995;**120**:718-31.
- 6 **Wise JB**. Ten year results of laser trabeculoplasty. Does laser avoid glaucoma surgery or merely defer it. *Eye* 1987;**1**:45-50.
- 7 **Odberg T**, Sandvik L. The medium and long term efficacy of primary argon laser trabeculoplasty in avoiding topical medication in open angle glaucoma. *Acta Ophthalmol* 1999;**77**:176-81.
- 8 **Fink AI**, Jordan AJ, Lao PN, *et al*. Therapeutic limitations of argon laser trabeculoplasty. *Br J Ophthalmol* 1988;**72**:263-9.
- 9 **Bergea B**, Bodin L, Svedbergh B. Primary argon laser trabeculoplasty vs pilocarpine: long term effects on intraocular pressure and facility of outflow. *Acta Ophthalmol* 1994;**72**:145-54.
- 10 **Sharma A**, Gupta A. Primary argon laser trabeculoplasty vs pilocarpine 2% in primary open angle glaucoma; two years follow up study. *Indian J Ophthalmol* 1997;**45**:109-13.
- 11 **Moulin F**, Haut J. Argon laser trabeculoplasty: a 10-year follow up. *Ophthalmologica* 1993;**207**:196-201.
- 12 **Shingleton BJ**, Richter CU, Dharma SK, *et al*. Long term efficacy of argon laser trabeculoplasty. A ten year follow up study. *Ophthalmology* 1993;**100**:1324-9.
- 13 **Grinich NP**, Buskirk MV, Samples JR. Three year efficacy of argon laser trabeculoplasty. *Ophthalmology* 1987;**94**:858-62.
- 14 **Adachi M**, Shirato S, Kaburagi T, *et al*. Ten year results of argon laser trabeculoplasty. *Nippon Ganka Gakkai Zasshi* 1994;**98**:374-8.
- 15 **Lotti R**, Traverso CE, Murialdo U *et al*. Argon laser trabeculoplasty; long term results. *Ophthalmic Surg* 1995;**26**:127-9.
- 16 **Ghosh B**, Gupta A. Argon laser trabeculoplasty for uncontrolled open angle glaucoma in Indian eyes. *Ann Ophthalmol* 1996;**28**:263-6.
- 17 **The Glaucoma Laser Trial Research Group**. The Glaucoma Laser Trial (GLT). Acute effects of argon laser trabeculoplasty on intraocular pressure. *Arch Ophthalmol* 1989;**107**:1135-42.



Readers' favourite

Top 10

Click on the "Top 10" button on the homepage to see which are the best read articles each month

www.bjophthalmol.com



Role of argon laser trabeculoplasty as primary and secondary therapy in open angle glaucoma in Indian patients

H C Agarwal, R Sihota, C Das, et al.

Br J Ophthalmol 2002 86: 733-736

doi: 10.1136/bjo.86.7.733

Updated information and services can be found at:

<http://bjo.bmj.com/content/86/7/733.full.html>

These include:

References

This article cites 16 articles, 3 of which can be accessed free at:

<http://bjo.bmj.com/content/86/7/733.full.html#ref-list-1>

Article cited in:

<http://bjo.bmj.com/content/86/7/733.full.html#related-urls>

Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections

Articles on similar topics can be found in the following collections

[Angle](#) (788 articles)

[Glaucoma](#) (776 articles)

[Intraocular pressure](#) (786 articles)

[Ophthalmologic surgical procedures](#) (962 articles)

Notes

To request permissions go to:

<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:

<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:

<http://group.bmj.com/subscribe/>