*Eye* (1991) **5**, 390–394

# Pilocarpine to Prevent Acute Pressure Increase Following Primary Laser Trabeculoplasty

T. ELSÅS,* H. JOHNSEN** AND Ø. STANG*
*Trondheim, Norway.*

**Summary**

**The effect of pilocarpine pretreatment on the transient pressure elevations immediately following primary laser trabeculoplasty was investigated in a prospective, randomised study. Fifty eyes of 50 patients, 33 with exfoliative and 17 with simple glaucoma, were treated in 360° of the trabecular meshwork. The mean maximum pressure increase was 2.4 (SD = 4.4)mm Hg with pilocarpine pretreatment and 12.8 (SD = 11.2)mm Hg without pretreatment ($p<0.05$). Except in two cases, all peak pressures appeared during the first two hours after treatment. The degree of chamber angle pigmentation was predictive of the magnitude of the post laser hypertensive pressure response in eyes without pretreatment ($p<0.05$).**

The most frequent and serious complication after laser trabeculoplasty (LTP) is acute pressure elevation.[1] There are several reports of visual field loss following LTP probably caused by pressure increase.[2–4] Laser trabeculoplasty was originally introduced as an alternative to filtration surgery,[5] and there are now several studies showing promising results with LTP as the initial treatment for glaucoma.[6–8] Pressure reducing agents such as pilocarpine,[9] acetazolamide,[10] and apraclonidine[11] reduce the pressure increase of LTP in glaucoma patients on medication prior to treatment, while anti-inflammatory drugs seem to have no effect.[12–14] We are only aware of one study on medical prophylaxis to prevent postoperative pressure elevations in primary LTP. Odberg[15] recorded no cases of pressure increase in an uncontrolled study of 27 eyes pretreated with timolol.

Fifty eyes of 50 patients were investigated in the present randomised study to determine the influence of pilocarpine pretreatment on post laser pressure elevation in primary LTP.

*Material and methods*

Fifty eyes of 50 patients were included, 33 with exfoliative glaucoma and 17 with simple glaucoma. The mean age of the patients was 69 (SD = 9.9) years in the pilocarpine pretreatment group and 71.9 (SD = 7.1) years in the untreated group.

To be included in the study, the patients had to meet the following criteria:

(a) Intraocular pressure ≥25mm Hg measured by applanation tonometry at the initial evaluation by one of the authors (TE) and just before laser treatment. The mean of these two was taken as prelaser IOP.
(b) Glaucomatous disc damage and/or visual field defects.
(c) No earlier glaucoma treatment.

The optic disc was evaluated by contact lens examination and nonstereo fundus photography by one of the authors (TE) according to the recommendations of Schwartz.[16] Glaucomatous disc damage was defined as vertical cup-disc ratio ≥0.5 and at least one of the following criteria:

From: Departments of Ophthalmology* and Clinical Chemistry**, University of Trondheim, Norway.
Correspondence to: T. Elsås, Department of Ophthalmology, University of Trondheim, N-7006, Norway.

(a) cupping of the optic nerve head extending to the margin of the disc.
(b) a difference of vertical cup-disc ratio of ≥0.2 between the two eyes.
(c) different degrees of disc pallor in the two eyes with no other explanation.

The visual field was examined with the Humphry visual field analyser using the C-30-2 program before and one, three, and six months after treatment. Glaucomatous visual field defects were defined as having at least three contiguous spots with a depth of ≥5 dB within the 30° central field. Three patients who did not cooperate when tested by automated perimetry had their fields plotted with the Goldmann perimeter. MD, the mean elevation or depression of the patient's overall field compared to the normal reference field in the STATPAC program of the Humphry visual field analyser, was used as an index of the degree of visual field damage. The visual field changes following LTP will be the subject of a separate study.

The degree of chamber angle pigmentation in the 6 o'clock position was graded according to Scheie on a scale from 0 to 4.[17]

Patients were randomly assigned to two drops of pilocarpine 2% pretreatment one hour before LTP or to no pretreatment. In cases with bilateral disease one eye was randomised to LTP. The study was not masked because the pilocarpine induced miosis was very obvious to the investigators.

Intraocular pressure was measured one, two, four, six, eight, and 24 hours after treatment with the Goldmann applanation tonometer. If the pressure was ≥50 mm Hg, the patient received glycerol, acetazolamide and timolol. The patients returned for repeat measurements one week and one, three, and six months after laser surgery. Topical antiglaucomatous medication was instituted if IOP was ≥40 mm Hg the day after treatment, ≥25 mm Hg after one week and >22 mm Hg after that.

We used the blue-green light of a Coherent argon laser photocoagulator. About a hundred burns were evenly spaced around 360° of the trabecular meshwork just in front of the scleral spur. We used the following settings: 0.1 sec. power duration, 50 μ spot size and a mean power level of 1.0 (SD = 0.2) W. All treatments were performed by one of the authors (TE) to maintain uniformity during the study.

The study took place from September 1989 to December 1990. Informed consent was obtained from all patients.

Multifactor analysis of variance (ANOVA) with two-way interaction was used to evaluate the effect of chamber angle pigmentation, glaucoma type, and prelaser pilocarpine treatment on pressure increase after treatment. For comparison of two mean values and of two frequencies, the t-test or binomial test was performed. A p-value less than 0.05 was considered significant.

## Results

Various prelaser and laser treatment parameters are listed in Table I. There is no evidence of dissimilarities between the two groups.

Data related to pressure increase are summarised in Table II and Figure 1. The mean maximum pressure increase was 2.4 (SD = 4.4) mm Hg in the pilocarpine group and 12.8 (SD = 11.2) mm Hg in the group not

**Table I.** *Prelaser and LTP parameters.*

| | *Pilocarpine pretreatment n = 25* | *No pilocarpine pretreatment n = 25* |
|---|---|---|
| Mean prelaser IOP (mm Hg) | 34.9 (SD = 8.1) | 33.3 (SD = 5.6) |
| Mean age | 69 (SD = 9.9) | 71.9 (SD = 7.1) |
| Number of eyes with exfoliative glaucoma | 16 | 17 |
| Number of eyes with simple glaucoma | 9 | 8 |
| Mean visual field defect (MD)(dB) | −6.7 (SD = 8.4) | −6.0 (SD = 9.7) |
| Cup-disc ratio | 0.7 (SD = 0.17) | 0.7 (SD = 0.17) |
| Pigmentation of chamber angle | 2.2 (SD = 0.9) | 2.3 (SD = 0.8) |
| Laser power (W) | 0.94 (SD = 0.2) | 1.03 (SD = 0.2) |
| Number of laser burns | 109 (SD = 15) | 104 (SD = 17) |

**Table II.** *Pressure increase following primary LTP*

| | *Pilocarpine pretreatment n = 25* | *No pilocarpine pretreatment n = 25* | *p-value* |
|---|---|---|---|
| Mean maximum pressure increase (mm Hg) | 2.4 (SD = 4.4) | 12.8 (SD = 11.2) | <0.05 |
| $\Delta P \geq 10$ mm Hg | n = 3 | n = 13 | <0.05 |
| $\Delta P \geq 20$ mm Hg | n = 0 | n = 8 | <0.05 |
| Peak IOP ≥50 mm Hg | n = 1 | n = 10 | <0.05 |

on pilocarpine ($P<0.05$). Table II demonstrates that pressure increase ≥10 mm Hg and ≥20 mm Hg and pressure peaks ≥50 mm Hg were more frequent without pilocarpine pretreatment ($P<0.05$). There were no cases of permanently elevated pressure following LTP.

ANOVA showed that pilocarpine pretreatment and chamber angle pigmentation were factors with significant effect on pressure increase after laser treatment ($p<0.05$). Specifically, pilocarpine generally reduced the pressure increase, and the reduction was higher the more pigmented the angle. This observation is clearly shown in Figure 1.

## Discussion

Our study demonstrates that pilocarpine pretreatment decreases the magnitude of the pressure rise after primary laser trabeculoplasty. To our knowledge only Odberg[15] has studied the influence of medical pretreatment on the immediate pressure response following primary LTP. He found no cases of postoperative pressure increase in an uncontrolled study of 27 timolol pretreated eyes with LTP over 180°. The disadvantage of timolol is that it cannot be used in patients with obstructive lung disease, and should be used with caution in cardiac patients.[18] Robin[11] reported that apraclonidine was superior to dipivefrin, timolol, acetazolamide and pilocarpine in preventing postlaser pressure elevations in patients on glaucoma medication. We are aware of no such comparative studies on the efficacy of different drugs in primary laser trabeculoplasty. Ofner *et al.*[9] reported that pilocarpine reduced the acute pressure increase after laser trabeculoplasty in patients on medication. Leung and Gillies[19] observed a trend towards diminished pressure increase in pilocarpine pretreated patients, but they did not consider it significant.

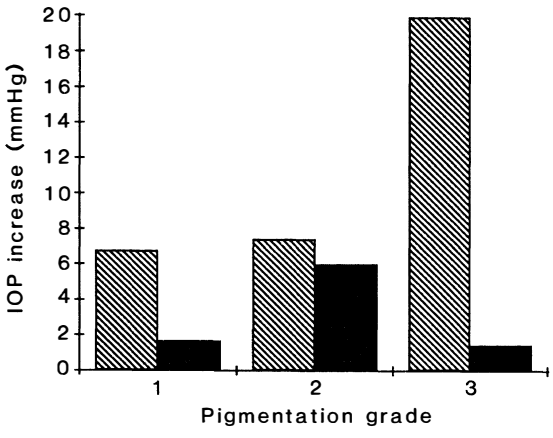


**Fig. 1.** *Pressure increase following primary LTP versus the degree of chamber angle pigmentation in pilocarpine pretreated eyes (black columns) and eyes receiving no pretreatment (hatched columns).*

In our study all except two patients experienced the pressure peaks during the first two hours after treatment. These two patients had maximum pressures three and five hours after laser trabeculoplasty. Even if most pressure spikes occur during the first hours after laser surgery, delayed pressure peaks may occur as late as 24 hours after treatment.[13] There was no difference in the time course of the pressure increase between the pilocarpine and non pilocarpine group in our study.

There are several theories that attempt to explain the hypertensive pressure response following LTP. Possible mechanisms are mechanical blockage of the outflow channels by trabecular tissue damage, obstruction of trabecular flow by entrapment of pigment and cellular debris, prostaglandine mediated pressure increase, and neuropeptide induced pressure rise.[20,21] The relationship between the degree of chamber angle pigmentation and the magnitude of the pressure increase

observed in our study and other reports[22,23] may support the theory of mechanical blockage. Laser treatment of heavily pigmented angles will often lead to release of pigment that can plug the trabecular meshwork. Heavy pigmentation of the angle will probably increase the absorption of energy and in this way lead to a more marked inflammatory reaction whch can contribute to the occlusion of outflow channels.

Weinreb *et al.* reported less pressure increase over 180° than over 360° LTP in glaucoma eyes on medication prior to treatment.[3] Primary LTP over 360° seems to be far more efficient than treatment of 180° of the trabecular meshwork.[24] Dividing 360° primary LTP in two 180° sessions did not reduce the post-laser hypertensive response when the IOP rise in both 180° sessions is taken into consideration.[25]

Our study was not masked because the pilocarpine induced miosis was very obvious. Apraclonidine, another agent used to prevent laser induced pressure elevations,[11,26] may also give the investigators clues to which eyes are pretreated. It can produce eyelid retraction, conjunctival blanching and mydriasis[26,27] and in this way unmask double-blind studies. We do not consider that the inherent bias in our study introduced by the conspicious pilocarpine miosis can explain the large difference in pressure increase between the pilocarpine and the untreated groups.

We recommend considering pilocarpine pretreatment to reduce pressure increase in primary LTP. All patients should be routinely monitored for two hours after treatment and patients with considerable glaucoma damage probably even longer to detect delayed pressure spikes.

Key words: Glaucoma, laser, laser surgery, laser trabeculoplasty.

## References


Hoskins HD, Hetherington J, Minckler DS, Lieberman MF, Shaffer RN: Complications of laser trabeculoplasty. *Ophthalmology* 1983, **90:** 796–9.

Thomas JV, Simmons RJ, Belcher CD: Argon laser trabeculoplasty in the presurgical glaucoma patient. *Ophthalmology* 1982, **89:** 187–97.

[3] Weinreb RN, Ruderman J, Juster R, Zweig K: Immediate intraocular pressure response to argon laser trabeculoplasty. *Am J Ophthalmol* 1983, **95:** 279–86.

Levene R: Major early complications of laser trabeculoplasty. *Ophthalmic Surg* 1983, **14:** 947–53.

[5] Wise JB: Long-term control of adult open angle glaucoma by argon laser treatment. *Ophthalmology* 1981, **88:** 197–202.

[6] Tuulonen A, Niva AK, Alanko HI: A controlled five-year follow-up study of laser trabeculoplasty as primary therapy for open-angle glaucoma. *Am J Ophthalmol* 1987, **104:** 334–8.

[7] Elsås T and Johnsen H: Long-term efficacy of primary laser trabeculoplasty. *Br J Ophthalmol* 1991, **75:** 34–7.

[8] The glaucoma laser trial research group: The glaucoma laser trial (GLT). 2. Results of argon laser trabeculoplasty versus topical medicines. *Ophthalmology* 1990, **97:** 1403–13.

[9] Ofner S, Samples JR, Van Buskirk EM: Pilocarpine and the increase in intraocular pressure after trabeculoplasty. *Am J Ophthalmol* 1984, **97:** 647–9.

[10] Metcalfe TW and Etchells DE: Prevention of the immediate intraocular pressure rise following argon laser trabeculoplasty. *Br J Ophthalmol* 1989, **73:** 612–6.

[11] Robin AL: The role of apraclonidine hydrochloride in laser therapy for glaucoma. *Trans Am Ophthalmol Soc* 1990, **87:** 729–61.

[12] Ruderman JM, Zweig KO, Wilensky JT, Weinreb RN: Effects of corticosteroid pretreatment on argon laser trabeculoplasty. *Am J Ophthalmol* 1983, **96:** 84–9.

[13] Pappas HR, Berry DP, Partamian L, Hertzmark E, Epstein DL: Topical indomethacin therapy before argon laser trabeculoplasty. *Am J Ophthalmol* 1985, **99:** 571–5.

[14] Dorigo MT, Dodo D, Cecchinato A: Aqueous prostaglandine $E_2$ and intraocular pressure after argon laser trabeculoplasty in glaucoma patients pretreated with topical piroxicam. *Int J Tiss Reac* 1987, **IX:** 73–5.

[15] Odberg T: Primary argon laser trabeculoplasty after pretreatment with timolol. A safe and economic therapy of early glaucoma. *Acta Ophthalmol* 1990, **68:** 317–9.

[16] Schwartz B: Cupping and pallor of the optic disc. *Arch Ophthalmol* 1973, **89:** 272–7.

[17] Scheie HG: Width and pigmentation of the angle of the anterior chamber. *Arch Ophthalmol* 1957, **58:** 510–2.

[18] Nelson WL, Fraunfelder FT, Sills JM, Arrowsmith JB, Kuritsky JN: Adverse respiratory and cardiovascular events attributed to timolol ophthalmic solution, 1978–1985. *Am J Ophthalmol* 1986, **102:** 606–11.

[19] Leung KW and Gillies WE: The detection and management of the acute rise in intraocular pressure following laser trabeculoplasty. *Aust NZ J Ophthalmol* 1986, **14:** 259–62.

[20] Koss MC, March WF, Nordquist RE, Gherezghiher T: Acute intraocular pressure elevation produced by argon laser trabeculoplaty in the cynomolgus monkey. *Arch Ophthalmol* 1984, **102:** 1699–703.

[21] Greenidge KC, Rodrigues MM, Spaeth GL, Traverso CE, Weinreb S: Acute intraocular pressure elevation after argon laser trabeculoplasty and iridectomy: A clinicopathologic study. *Ophthalmic Surg* 1984, **15:** 105–10.

[22] Glaucoma laser trial research group: 1. Acute effects of argon laser trabeculoplasty on intraocular pressure. *Arch Ophthalmol* 1989, **107:** 1135–42.

[23] Webers CAB and Hendrikse F: A prospective study on variables in patients with intraocular pressure rises following argon laser trabeculoplasty. *Laser and Light in Ophthalmology* 1990, **3:** 111–7.

[24] Elsås T: Primary laser trabeculoplasty: a comparison of 50 spots in 180° and 100 spots in 360° of the trabecular meshwork. *Acta Ophthalmol* 1987, **65:** 323–5.

[25] Elsås T, Johnsen H, Brevik TA: The immediate pressure response to primary laser trabeculoplasty—comparison of one- and two-stage treatment. *Acta Ophthalmol* 1989, **67:** 664–8.

[26] Brown RH, Stewart RH, Lynch MG, *et al.*: ALO 2145 reduces the intra-ocular pressure elevation after anterior segment laser surgery. *Ophthalmology* 1988, **95:** 378–84.

[27] Robin AL: Short-term effects of unilateral 1% apraclonidine therapy. *Arch Ophthalmol* 1988, **106:** 912–5.