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Response of exfoliation glaucoma to laser trabeculoplasty

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SUMMARY The comparative response of exfoliation (EF) glaucoma and primary open-angle glaucoma (POAG) to laser trabeculoplasty (LTP) was studied retrospectively. The effectiveness of argon laser trabeculoplasty (LTP) was compared in 26 eyes of patients with EF glaucoma (uncontrollable by maximally tolerated medical therapy) and 28 eyes of patients with POAG (controls). 64% of the POAG group and 46% of the EF glaucoma group received treatment of the entire angle in two divided sessions in order to reduce the intraocular pressure (IOP) to ≤22 mmHg. All second treatments were performed at least four to six weeks after the initial session. Evaluation of the postoperative course of IOP by means of the Kaplan-Meier curve for data analysis indicated that EF patients 'failed' at a faster rate than POAG patients after both the initial and consecutive laser treatments. The rate of failure in the EF group, however, was greater following the initial 180° treatment. Although patients with EF glaucoma have a large initial reduction in intraocular pressure after LTP, to increase the probability of maintaining intraocular pressures of ≤22 mmHg consecutive 180° treatments should be considered.

Laser trabeculoplasty (LTP) has proved effective in lowering the intraocular pressure (IOP) of patients with primary open-angle (POAG) and other secondary glaucomas. Patients with exfoliation glaucoma (EF), for example, have a significant reduction in intraocular pressure after laser treatment. Ritch and Podos, summarising the results from eight series of EF patients (n=111), reported that 94 had reduced intraocular pressures after LTP, obviating the need for filtration surgery.[1] Moreover, their data suggested that LTP was more successful in treating patients with EF than with POAG. In the series reported by Thomas *et al.*[2] laser therapy was successful in 97·1% of patients with EF glaucoma versus 85·2% with POAG. Zborowski *et al.* noted a similar trend, but the difference was not statistically significant.[3] The rate of failure reported after LTP is also low for EF patients. Of the 34 patients in the series of Thomas *et al.*[2] only one failed. Ritch and Podos[1] found only four treatment failures in a series of 15 EF patients, which had a range of follow-up of three months to two years.

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Thus, it would appear that LTP is effective in treating patients with EF glaucoma. The difference between EF and POAG with respect to rate of failure after LTP has not been addressed. A retrospective investigation was undertaken to examine this issue.

Patients and methods

All data were taken from the files and records of the Glaucoma Consultation Service of the Massachusetts Eye and Ear Infirmary. The effectiveness of LTP was examined in 26 eyes of patients with EF who had progressive optic disc and visual field deterioration with poor IOP control despite maximally tolerated medical therapy. The eyes in the experimental group were compared with 28 lasered eyes randomly selected from the POAG population of the Glaucoma Consultation Service. EF glaucomatous eyes were characterised clinically by (*a*) the presence of 'flakes' on the anterior capsule of the lens, and (*b*) perimarginal pupillary atrophy associated with open-angle glaucoma. The POAG patients also qualified as candidates for LTP on the basis of field and disc progression while on maximally tolerated medical therapy. The controls were matched with the

experimental group according to the date of the laser treatments and age. Cases with a history of previous ocular surgery, trauma, or uveitis were excluded. All patients were phakic and over 55 years of age.

All patients had been treated with an argon laser (Coherent Model 900) by the technique of Wise and Witter.[4] The average laser energy was 5·5 joules for the EF group. The average number of shots in the eyes per 180° of treatment was 48 (SD8) for the POAG eyes and 53 (SD11) for the EF eyes ($p<0·05$) The power range was 700–1250 mW, and the duration was always 0·1 s. All patients continued their antiglaucoma medications preoperatively and were placed on topical steroids for five days after laser therapy. Some eyes were treated in two sessions (180° each session). However, if the initial session resulted in reduced intraocular pressures such that the patient's glaucoma was no longer progressive, the remaining 180° of the angle was left untreated.

A failure was defined as any eye with intraocular pressure greater than 22 mmHg one month or more after LTP, or any eye requiring filtering surgery. Eyes requiring second laser treatments were not necessarily considered failures.

Kaplan-Meier survival curves[5] were used to analyse the time course of failure in the various subgroups. Student's *t* test was used to compare follow-up IOP data with baseline data. Independent sample *t* tests were used to compare the EF and POAG groups.

The mean age was 70 (SD11) years in the POAG group versus 75 (SD7) years in the EF group ($p<0·05$). The mean age of patients was 72 (SD7) years for those with unilateral EF ($p<0·01$). Twelve eyes were studied from patients with unilateral EF and 14 eyes from patients with bilateral EF.

The mean preoperative IOP in the POAG group was 22·4 (SD3·8) mmHg versus 25·5 (SD7·8) mmHg in the EF group ($p<0·08$). The average postoperative pressure after the initial laser treatment at four to six weeks was 17·3 (SD4·5) mmHg for the controls versus 19·1 (SD6·0) mmHg for the EF glaucoma group. The mean IOP seven to eight weeks after the first laser treatment in the control group was 16·5 (SD4·8) mmHg and 15·8 (SD7·9) mmHg in the EF group.

A greater reduction in IOP was observed in the EF glaucoma group compared with the POAG group after the initial 180° laser treatment ($p<0·10$). At seven to eight weeks after LTP the difference was −5·6 (SD4·8) mmHg in the EF group.

The difference between groups after the second laser treatment was not as marked. The mean IOP prior to the second laser treatment was 18·9 (SD2·7) mmHg for the control group and 23·4 (SD9·7) mmHg for the EF group. At four to six weeks after the second laser treatment the mean IOP for the control group was 16·1 (SD2·1) mmHg and 18·5 (SD3·9) mmHg for the EF group.

Table 1 *Pressure reduction after initial laser treatment: cumulative probability of maintaining intraocular pressure ≤22 mmHg*

Follow-up time (weeks)	*POAG (%)*	*Exfoliation glaucoma (%)*		
		All	*Unilateral*	*Bilateral*
4–6	88	74	64	92
7–8	83	74	64	92
12	77	74	64	92
33	77	59	51	73
59	64	59	*	*

*Data are presented only for categories where the denominator was at least 5.

Percentage of 'successful' patients remaining in the POAG, unilateral EF, and bilateral EF groups at increasing periods of follow-up after treatment of the initial 180° of angle. Data were analysed by Kaplan-Meier survival curves.

The relative failure rates were assessed by the Kaplan-Meier curve. The data were analysed in two groups: (1) IOP after treatment of the initial 180° (Table 1), and (2) IOP after treatment of the second 180° (Table 2). After the first treatment a greater percentage of patients failed to achieve acceptable pressures in both the unilateral and bilateral EF glaucoma groups than in the POAG group. After the second laser treatment more patients in the unilateral EF glaucoma group failed than in the POAG group. The sample with bilateral EF glaucoma was too small to analyse.

Mild transient uveitis occurred in all patients after LTP and was successfully treated with topical steroids. No irreversible complications, such as corneal burns or permanent PAS peripheral anterior synechiae, were noted. Four controls and one unilateral EF patient required filtration surgery at 12, 43, 47, 77, and 47 weeks respectively.

Table 2 *Pressure reduction after final laser treatment: cumulative probability of maintaining intraocular pressure ≤22 mmHg*

Follow-up time (weeks)	*POAG (%)*	*Exfoliation glaucoma (%)*	
		All	*Unilateral*
4–6	100	91	83
7–8	88	71	67
33	59	*	*
59	59	*	*

*Data are presented only for categories where the denominator was at least 5.

Percentage of 'successful' patients remaining in the POAG and unilateral EF, at increasing periods of follow-up after treatment of the consecutive 180° of angle. Data were analysed by Kaplan-Meier survival curves.

Discussion

The results of this investigation suggest a greater failure rate for eyes with EF glaucoma than in a group of POAG controls. It is possible that these failures may be unrelated to loss of efficacy of LTP; rather they may be a reflection of the natural course of EF glaucoma. Alternatively, the fact that more POAG patients in this series underwent treatment of the full 360° of the trabecular meshwork may also have affected the outcome. It has been suggested that treatment of the entire angle is necessary to maintain a reduction of IOP.[6] Our findings suggest that the trabecular meshwork of patients with EF glaucoma should be treated for the full 360°, despite the ability to achieve pressures ≤22 mmHg and even when the optic disc or visual field do not deteriorate further. The benefits of 360° treatment, however, must also be weighed against the possible risk of increasing the intraocular pressure. Thomas *et al.*,[2] for example, observed a risk of worsening the glaucoma status after trabeculoplasty.

The current series also suggests that EF patients with unilateral disease respond less well to laser therapy than EF patients with bilateral disease. Three postulates are the following: (1) The trabecular meshwork of patients with unilateral EF glaucoma may be more resistant to the effects of laser. (2) Physicians treating patients with unilateral EF tend to wait longer before performing LTP because the patient is less impaired. (3) Because the bilateral EF patients in this series were older (78 (SD7) years bilateral EF versus 72 (SD7) years unilateral EF), the success of LTP may have been enhanced. Richardson and Epstein have shown trabecular beams in EF glaucoma to be intact, unlike the denuded, collapsed beams of pigmentary glaucoma.[7] Although morphological differences have been noted between EF glaucoma and other glaucomas, there is no evidence so far of differences between unilateral and bilateral EF. Further histological studies would be necessary to determine whether any morphological or biochemical differences exist between eyes with unilateral versus bilateral EF.

The EF cases in this series had a greater reduction of IOP than the POAG controls. This finding agrees with the series of patients reported on by Thomas *et al.*[2] On the other hand a higher preoperative IOP (25·5 (SD7·8) mmHg for EF versus 22·4 (SD3·8) mmHg for POAG) predicts a greater change in pressure after laser treatment. Another explanation may be related to the greater degree of pigmentation found in angles with EF. It is possible, for instance, that the thermal effect of laser treatment is more effectively absorbed in angles containing greater amounts of melanin.

The high percentage of 'failure' in the EF group may be attributed to the very narrow definition of failure in this study. Our criteria did not account for fluctuations in IOP as a function of time. Perhaps intraocular pressures greater than 22 mmHg measured in two consecutive visits would have been a better criterion. Nevertheless the same criteria were applied to both groups.

The results of this study clearly point to the need for a prospective investigation on a larger series of patients and standardisation of treatment. Although patients with EF appear to fail at a faster rate than patients with POAG, LTP remains an important adjunct to the management of EF glaucoma. Patients who maintain pressures in the high teens after 180° laser treatments should be considered for consecutive treatments in order to ensure maintenance of reduced intraocular pressure, and patients should be closely monitored for any deterioration of visual field and optic disc after laser therapy to evaluate the need for filtration surgery.

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