

Research article/Raziskovalni prispevek

COMPARATIVE STUDY OF THE EFFICACY OF SELECTIVE LASER TRABECULOPLASTY FOR PSEUDOEXFOLIATION GLAUCOMA AND PRIMARY OPEN-ANGLE GLAUCOMA

PRIMERJAVA UČINKOVITOSTI SELEKTIVNE LASERSKE TRABEKULOPLASTIKE PRI PSEUDOEXFOLIACIJSKEM GLAVKOMU IN PRIMARNEM GLAVKOMU Z ODPRTIM ZAKOTJEM

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Key words: selective laser trabeculoplasty; pseudoexfoliation glaucoma; primary open-angle glaucoma; comparative study; efficacy

Abstract – Background. To compare the efficacy of selective laser trabeculoplasty (SLT) as treatment of pseudoexfoliation glaucoma (PG) and primary open-angle glaucoma (POAG) in a prospective clinical study.

Methods. Ten eyes of 10 patients suffering from uncontrolled PG (PG group) and 10 eyes of 10 patients with uncontrolled POAG (POAG group) were treated with a frequency-doubled, Q-switched Nd:YAG laser (532 nm). The baseline characteristics were similar in both groups. The intraocular pressure (IOP) was measured before the treatment and 1 day, 1 week, 1 month and 3, 6, 9, 12, 15, 18, 24, 30, and 36 months after the treatment. Success was defined as an IOP lowering, exceeding 20% of pretreatment IOP. Any modification of hypotensive medication led to exclude the eye from the study. Statistical analysis comparing the two groups was carried out using the independent-sample *t* test for continuous variables and the Log-Rank test for survival analysis. All tests were conducted considering $p < 0.05$ as significant.

Results. The mean follow-up time was 22.8 months (SD 12.5) for the PG group and 24.3 months (SD 10.8) for the POAG group (*n. s.*). No significant difference was found between the two groups for mean pretreatment IOP (23.6 mm Hg [SD 5.7] in the PG group vs. 22.8 mm Hg [SD 2.4] in the POAG group) and for mean IOPs during the whole follow-up period. At all follow-up visits, the mean IOP reductions were smaller in the PG group than in the POAG group (7.0 mm Hg [SD 3.3] vs. 7.7 mm Hg [SD 2.0] at 24 months). However such difference was statistically significant only at 36 months (4.7 mm Hg [SD 1.1] vs. 8.3 mm Hg [SD 1.5]). At all follow-up visits, the mean percent IOP reduction was smaller in the PG group than in the POAG group (27.6% [SD 7.1] vs. 32.1% [SD 7.1] at 24 months). Furthermore, such a difference was statistically significant at 9, 12, and 36 months (21.8% [SD 1.6] vs. 34.1% [SD 4.7]). According to the Kaplan-Meier survival analysis, the 36-month success rate was 47% in the PG group and 59%

Ključne besede: selektivna laserska trabekuloplastika; pseudoeksfoliacijski glavkom; primarni glavkom z odprtim zakotjem; primerjava učinkovitosti

Izvleček – Izhodišča. Primerjati učinkovitost selektivne laserske trabekuloplastike (SLT) pri zdravljenju pseudoeksfoliacijskega glavkoma (PG) in pri primarnem glavkomu z odprtim zakotjem (POAG) s prospektivno klinično raziskavo.

Metode. 10 oči 10 bolnikov z neurejenim PG (skupina PG) in 10 oči 10 bolnikov z neurejenim POAG (skupina POAG) je bilo zdravljenih s frekvenčno podvojenim, Q-preklopljenim laserjem Nd:YAG (532 nm). Osnovne značilnosti so bile podobne v obeh skupinah. Očesni pritisk (IOP) je bil izmerjen pred zdravljenjem in nato 1 dan, 1 teden, 1 mesec ter 3, 6, 9, 12, 15, 18, 24, 30 in 36 mesecev po SLT. Uspeh je bil določen z znižanjem IOP, ki je bilo večje kot 20% glede na IOP pred zdravljenjem. Vsaka sprememba lokalnega protiglavkomskega zdravljenja je vodila v izključitev očesa iz klinične raziskave. Statistična analiza primerjave dveh skupin je bila narejena s testom *t* neodvisnih vzorcev in testom Log-Rank za analizo preživetja. Pri vseh testih je bil $p < 0,05$ upoštevan kot statistično značilen.

Rezultati. Za skupino PG je bil povprečen čas opazovanja 22,8 meseca (SD 12,5), za skupino POAG pa 24,3 meseca (SD 10,8), (stat. nezn.). Med povprečnima IOP pred zdravljenjem obeh skupin ni bilo statistično značilne razlike (23,6 mm Hg [SD 5,7] v skupini PG proti 22,8 mm Hg [SD 2,4] v skupini POAG), prav tako pa tudi ne med povprečnima IOP po zdravljenju v celotnem času opazovanja. Pri vseh kontrolah po SLT je bilo povprečno znižanje IOP manjše v skupini PG kot v skupini POAG (7,0 mm Hg [SD 3,3] proti 7,7 mm Hg [SD 2,0] pri 24 mesecih), vendar pa je bila razlika statistično značilna le pri 36 mesecih (4,7 mm Hg [SD 1,1] proti 8,3 mm Hg [SD 1,5]). Pri vseh kontrolah po SLT je bil povprečen odstotek znižanja IOP manjši v PG skupini kot v POAG skupini (27,6% [SD 7,1] proti 32,1% [SD 7,1] pri 24 mesecih), razlika pa je bila statistično značilna pri 9, 12 in 36 mesecih (21,8% [SD 1,6] proti 34,1% [SD 4,7]). Glede na Kaplan-Meierjevo analizo preživetja je bila 36-mesečna uspešnost v skupini PG 47% in v sku-

in the POAG group, but the differences between the two groups were nonsignificant ($p > 0.05$).

Conclusions. SLT is an effective procedure for lowering IOP, although within 3 years there has been a substantial failure rate in both PG and POAG eyes, and the success seems to decline faster in PG eyes.

pini POAG 59%, vendar pa je bila razlika med skupinama statistično neznačilna ($p > 0,05$).

Zaključki. SLT je učinkovita metoda za znižanje IOP, čeprav smo v 3 letih opazovanja ugotovili padec učinkovitosti tako pri očeh s PG kot pri očeh s POAG. Kaže, da uspešnost hitreje pada pri očeh s PG.

Introduction

Laser trabeculoplasty is a commonly accepted therapy for lowering of the intraocular pressure (IOP) in eyes with medically uncontrolled open-angle glaucoma (1). Different types of lasers with various wavelengths are used. The most commonly used laser for trabeculoplasty is the argon laser. It has been in use since 1979 when the first successful protocol of argon laser trabeculoplasty (ALT) was described (2). ALT is an effective treatment modality for lowering the IOP in patients with open angle glaucoma (1–5). Since 1998, the first successful protocol of selective laser trabeculoplasty (SLT) has been described, a 532 nm Q-switched frequency doubled Nd:YAG laser has also been used in the treatment of open angle glaucoma (6). In clinical studies SLT, appears to be a safe and effective method to lower the IOP in eyes with uncontrolled open-angle glaucoma (6–12).

This prospective clinical study compares the efficacy of SLT for lowering the IOP in the treatment of pseudoexfoliation glaucoma (PG) and primary open-angle glaucoma (POAG). It represents the long term follow-up results of our already published study, which was the first and so far the only reported prospective clinical trial comparing the IOP response of PG and POAG to SLT (12).

Methods

The patients selected for this prospective clinical study were recruited from the glaucoma unit of the Department of Ophthalmology, General Hospital Maribor, Maribor, Slovenia, between March and December 1999. In the study, we included 10 consecutive patients who had PG – the PG group and 10 consecutive patients who had POAG – the POAG group, with the uncontrolled IOP (> 18 mm Hg) on maximally tolerated medical therapy. Patients of either gender, older than 65 years, were included. Baseline examinations included variables such as age, sex, a history of past and present ocular medication, and ocular history. Patients were excluded from this study if they demonstrated a history of previous ocular surgery, ocular trauma, laser therapy, or uveitis to the study eye. Thus 16 eyes of 10 patients (6 bilateral) were included in the PG group and 18 eyes of 10 patients (8 bilateral) in the POAG group. In all bilateral cases, only one eye per patient was included in the study. The eyes were randomly selected using a random number table; right eyes associated with even numbers, left eyes with odd numbers. An eye examination included determination of visual acuity, refraction, a slit lamp examination, ophthalmoscopy, computerized perimetry, and gonioscopy. Trabecular meshwork pigmentation was graded according to a standard scale (graded from 0 to 4+ where 0 = no pigment, and 4+ = dense homogeneous pigment). The IOP was measured with a Goldmann applanation tonometer at least three times, at approximately the same time of the day (plus or minus 1 hour) to minimize diurnal variation of the IOP, in the 4 weeks before the laser treatment was performed. The average of the preoperative IOPs was used as the baseline IOP. On the day of SLT, the IOP was checked and one drop of 0.5% apraclonidine was

instilled in the study eye one hour before treatment. The trabecular meshwork of each eye was treated in the inferior 180 degrees with a 532 nm frequency doubled Q-switched Nd:YAG laser (Selecta 7000; Coherent, Palo Alto, CA, USA). The pulse duration was 3 ns with a single pulse and the spot size was 400 microns. Treatment was conducted with adjacent, but not overlapping spots. The initial energy used was 0.8 mJ. The energy was increased or decreased until bubble formation appeared, and was then decreased by 0.1 mJ for the remainder of the treatment. A drop of 0.5% apraclonidine was instilled in all treated eyes post-laser. Dexamethasone-Neomycine eye drops were prescribed after treatment four times a day for 7 days. All the eyes underwent a slit lamp examination and applanation tonometry 1 hour and 3 hours post-laser to assess the anterior chamber reaction and IOP spikes. Patients were evaluated 1 day, 7 days, 1 month, 3 months, and then 6, 9, 12, 15, 18, 24, 30 and 36 months after treatment. At all follow up examinations, the IOP was measured at approximately the same time of the day (plus or minus 1 hour) to minimize diurnal variation of IOP. A failure was defined as any eye with IOP reduction less than 20% from baseline IOP on two successive occasions from 1 month post-laser, or any eye with progression of visual field and optic disc damage, and requiring filtering surgery. Hypotensive medical therapy was not modified during the study period. When any eye required either an alteration of hypotensive medical therapy or filtering surgery, thus failed to respond to SLT, that eye was excluded from further analysis at that point. Independent sample t tests were used in statistical analyses of comparing the PG and the POAG groups. Significant p values were considered to be less than 0.05. All tests were performed two tailed. Because of the variability in the length of the follow-up among patients, Kaplan-Meier life-table (survival) analysis was used to estimate the success rates for the PG and POAG groups. The two survival curves (success rates) were compared using the Log-Rank test.

Results

In the PG group there were 10 eyes of 10 patients and in the POAG group 10 eyes of 10 patients. The baseline characteristics including number of patients, number of eyes, age, sex, number of hypotensive medications, ocular history, trabecular meshwork pigmentation and mean baseline IOP of the PG group and the POAG group are listed in Table 1. The differences between those baseline characteristics were not statistically significant ($p > 0.05$), except the difference between trabecular meshwork pigmentation, which was statistically significant ($p < 0.02$).

Treatment with SLT was conducted in all eyes with adjacent spots. The mean number of spots applied in the PG group was 51.2 (SD 2.0) and in the POAG group 50.3 (SD 0.7); the difference was not statistically significant ($p > 0.05$). Energies that were used, were in the PG group between 0.47 mJ and 0.75 mJ with the mean energy of 0.59 mJ for each spot, and in the POAG group between 0.56 mJ and 0.92 mJ with the mean energy of 0.72 mJ for each spot; the difference was statistically significant ($p < 0.02$).

Table 1. *Baseline characteristics.*

Razpr. 1. *Osnovne značilnosti.*

	PG	POAG	p
Patients (No) Bolniki (št.)	10	10	> 0.05
Eyes (No) Oči (št.)	10	10	> 0.05
Age (years) (SD) Starost (leta) (SD)	74.9 (4.4)	76.7 (5.1)	> 0.05
Sex / Spol male / moški female / ženski	2 8	2 8	> 0.05
Hypotensive medication (mean) (SD) Antiglavkomska terapija (povprečno) (SD)	2.4 (0.7)	2.3 (0.5)	> 0.05
Previous ocular surgery, laser th., trauma, uveitis Poprejšnja očesna kirurgija, lasersko zdravljenje, travma, uveitis	0	0	> 0.05
Trabecular meshwork pigmentation (mean) (SD) Pigmentacija trabekula (povprečno) (SD)	2.6 (0.84)	1.6 (0.84)	< 0.02
Mean baseline IOP (mm Hg) (SD) Povprečni osnovni IOP (mm Hg) (SD)	23.60 (5.70)	22.80 (2.44)	> 0.05
PG – Pseudoexfoliation glaucoma group Skupina s psevdooksfoliacijskim glavkomom			
POAG – Primary open-angle glaucoma group Skupina s primarnim glavkomom odprtega zakotja			
No – Number Št. – Število			
(SD) – Standard deviation Standardna deviacija			
p – Independent sample t test T test neodvisnih vzorcev			
IOP – Intraocular pressure Očesni pritisk			

The mean follow-up time was for the PG group 22.8 (SD 12.5) months (range 6–36 months) and for the POAG group 24.3 (SD 10.8) months (range 6–36 months); the difference was not statistically significant ($p > 0.05$).

The mean IOPs, mean IOP reduction, and mean percent IOP reduction from baseline IOP 1 day, 7 days, 1 month, 3, 6, 9, 12, 15, 18, 24, 30, and 36 months after treatment for the PG and POAG groups are listed in Table 2. The differences in the mean IOPs at different time intervals following SLT between the two groups were not statistically significant ($p > 0.05$). At all follow-up visits, the mean IOP reductions were smaller in the PG group than in the POAG group (7.0 mm Hg [SD 3.3] vs. 7.7 mm Hg [SD 2.0] at 24 months), but such difference was statistically significant ($p < 0.05$) only at 36 months (4.7 mm Hg [SD 1.1] vs. 8.3 mm Hg [SD 1.5]). At all follow-up visits, the mean percent IOP reduction was smaller in the PG group than in the POAG group (27.6% [SD 7.1] vs. 32.1% [SD 7.1] at 24 months), and such a difference was statistically significant ($p < 0.05$) at 9 months (22.9% [SD 5.8] vs. 30.3% [SD 6.8]), 12 months (22.1% [SD 5.9] vs. 30.6% [SD 6.3]), and 36 months (21.8% [SD 1.6] vs. 34.1% [SD 4.7]).

In the PG group, 5 eyes failed to respond to SLT (1 eye after 6 months, 2 eyes after 9 months, 1 eye after 12 months, and 1 eye after 30 months), and in the POAG group 4 eyes failed to respond to SLT (1 eye after 6 months, 1 eye after 9 months, 1 eye after 18 months, and 1 eye after 24 months). The success rate after 36 months determined from Kaplan-Meier life-table (survival) analysis was 47% in the PG group and 59% in the POAG group. By the comparison of the two survival curves (success rates) with the Log-Rank test, there was no statistically significant difference ($p > 0.05$) between the groups.

In the PG group, 1 hour after treatment a transient increase in IOP occurred in 1 eye (10%) for 1 mm Hg and in 1 eye (10%) for 3 mm Hg; 3 hours after treatment a transient increase in IOP occurred in 1 eye (10%) for 1 mm Hg and in 2 eyes (20%) for 3 mm Hg. In the POAG group a transient increase in IOP 3 hours after treatment occurred only in 1 eye (10%) for 2 mm Hg. The IOP elevations were not treated with additional antiglaucoma medications and resolved in all cases within 12 hours.

Significant anterior segment inflammation was not detected after SLT in any of the eyes. None of the patients complained of pain or any discomfort during treatment.

Discussion

SLT is a laser procedure that selectively targets pigmented trabecular meshwork cells without causing thermal damage or collateral damage to nonpigmented cells or structures (13). For SLT, a 532 nm Q-switched frequency doubled Nd:YAG laser with a single pulse of short duration (in the microsecond range) and low fluence (energy/area) is used (13). The exact mechanism of the action of reducing the IOP in this procedure is not known. The demonstrable clinical efficacy of SLT, despite the absence of coagulation of the trabecular meshwork suggests that laser trabeculoplasty works on the cellular level either through migration and phagocytosis of trabecular meshwork debris by the macrophages or by stimulation of formation of healthy trabecular tissue which may enhance the outflow properties of the trabecular meshwork (14). Alvarado et al. has observed a 5 to 8 fold increase in the number of monocytes and macrophages present in the trabecular meshwork of monkey eyes treated with SLT as compared with untreated controls (15). They theorized that the injury to the pigmented trabecular meshwork cells after SLT results in the release of factors and chemoattractants which recruit monocytes which are activated and transformed into macrophages upon interacting with the injured tissues. These macrophages then engulf and clear the pigment granules from the trabecular meshwork tissues, and exit the eye to return to the circulation via the Schlemm's canal (15). All these events have been postulated to play a role in the IOP lowering effect of SLT (14).

PG is basically treated the same as POAG, although it has been emphasized that PG is more difficult to control and responds poorly to medical therapy (16, 17). ALT is recommended in the treatment of PG because of the rather marked reduction of IOP (1). In comparative studies, the IOP response of PG and POAG to ALT is already presented (18–21).

SLT appears to be a safe and effective method of lowering the IOP in eyes with uncontrolled open-angle glaucoma (6–12). The present prospective clinical study compared the efficacy of SLT for lowering the IOP in the treatment of PG and POAG. It represents the long term follow-up results (with the mean follow-up of 22.8 months for the PG group and 24.3 months for the POAG group) of our already published study (with the mean follow-up of 12.0 months for the PG group and 13.5 months for the POAG group) (12). No significant difference was found between the two groups for mean pretreatment IOP and for mean IOPs during whole follow-up period. At all follow-up visits, the mean IOP reductions were smaller in the PG group than in the POAG group, but such difference was statistically significant only at 36 months. At all follow-up visits, the mean percent IOP reduction was smaller in the PG group than in the POAG group and such a difference was statistically significant at 9, 12 and 36 months (Table 2). Kaplan-Meier survival analysis gave a 36-month success rate of 47% in the PG group and 59% in the POAG group, but this difference was not significant.

Table 2. Mean IOP, mean IOP reduction, mean percent IOP reduction from baseline IOP at different time intervals following SLT.

Razpr. 2. Povprečni IOP, povprečno znižanje IOP, povprečen procent znižanja IOP od osnovnega IOP ob različnih časovnih intervalih po SLT.

Follow-up time Čas opazovanja	Eyes (No) Oči (št.)		Mean IOP (mm Hg) (SD) Povprečni IOP (mm Hg) (SD)			Mean IOP reduction (mm Hg) (SD) Povprečno znižanje IOP (mm Hg) (SD)			Mean % IOP reduction (SD) Povprečni % znižanja IOP (SD)		
	PG	POAG	PG	POAG	p	PG	POAG	p	PG	POAG	p
Baseline Osnova	10	10	23.6 (5.7)	22.8 (2.4)	> 0.05	-	-	-	-	-	-
1 day 1 dan	10	10	16.4 (4.0)	17.6 (2.4)	> 0.05	7.2 (3.0)	5.2 (3.5)	> 0.05	29.9 (10.0)	22.0 (13.2)	> 0.05
7 days 7 dni	10	10	18.2 (6.1)	18.3 (1.5)	> 0.05	5.2 (3.8)	4.5 (2.7)	> 0.05	22.7 (15.9)	19.0 (10.2)	> 0.05
1 month 1 mesec	10	10	18.4 (6.3)	16.7 (1.8)	> 0.05	5.2 (3.4)	6.1 (3.0)	> 0.05	23.3 (13.6)	26.0 (11.5)	> 0.05
3 months 3 mesece	10	10	18.3 (5.4)	16.7 (2.5)	> 0.05	5.3 (1.7)	6.1 (1.7)	> 0.05	22.9 (8.4)	26.8 (6.7)	> 0.05
6 months 6 mesecev	9	9	17.5 (4.3)	16.6 (1.6)	> 0.05	6.0 (3.2)	6.5 (2.7)	> 0.05	24.8 (11.1)	27.7 (9.9)	> 0.05
9 months 9 mesecev	7	8	18.0 (4.4)	16.2 (0.7)	> 0.05	5.6 (2.9)	7.2 (2.1)	> 0.05	22.9 (5.8)	30.3 (6.8)	< 0.05
12 months 12 mesecev	6	8	18.8 (4.2)	16.2 (1.5)	> 0.05	5.7 (3.2)	7.2 (1.8)	> 0.05	22.1 (5.9)	30.6 (6.35)	< 0.05
15 months 15 mesecev	6	8	17.8 (3.8)	16.7 (1.5)	> 0.05	6.6 (3.3)	6.7 (1.7)	> 0.05	26.1 (5.1)	28.5 (6.1)	> 0.05
18 months 18 mesecev	6	7	17.3 (4.3)	15.7 (0.7)	> 0.05	7.1 (3.1)	7.4 (2.0)	> 0.05	28.4 (6.2)	31.6 (6.9)	> 0.05
24 months 24 mesecev	6	6	17.5 (4.2)	16.0 (1.2)	> 0.05	7.0 (3.3)	7.6 (2.0)	> 0.05	27.6 (7.1)	32.1 (7.1)	> 0.05
30 months 30 mesecev	4	4	19.2 (6.1)	16.0 (1.1)	> 0.05	7.0 (3.4)	8.2 (0.9)	> 0.05	26.7 (8.2)	34.0 (3.4)	> 0.05
36 months 36 mesecev	3	3	17.6 (3.2)	16.0 (1.0)	> 0.05	4.7 (1.1)	8.3 (1.5)	< 0.05	21.8 (1.5)	34.1 (4.7)	< 0.05

PG - Pseudoexfoliation glaucoma group
Skupina s psevdoksfoliacijskim glavkomom
POAG - Primary open-angle glaucoma
Skupina s primarnim glavkomom odprtega zakotja
No - Number
Št. - Število
(SD) - Standard deviation
Standardna deviacija
p - Independent sample t test
T-test neodvisnih vzorcev
IOP - Intraocular pressure
Očesni pritisk

The main pathogenic factor causing elevated IOP in PG is obstruction of the trabecular meshwork by excessive exfoliation material (22, 23). We believe that the higher failure rate in PG group is a reflection of this natural course of PG. The fact that in the PG group the energies that were used, were lower than in the POAG group, can be explained by the greater degree of trabecular meshwork pigmentation in the PG group and the same laser treatment protocol for each eye enrolled in the study. 1-3 hours after treatment, a transient increase in IOP was fairly common in the PG group and not significant in the POAG group, despite the lower energies for treatment which were used in the PG group. Therefore, we think that patients with PG need particularly careful monitoring during the initial hours following SLT.

Several investigators have shown in comparative studies of the efficacy of ALT for PG and POAG that the lowering IOP effect diminishes with time (18-21). ALT improves the outflow of aqueous by photocoagulation of the trabecular meshwork and causes coagulative damage to the trabecular meshwork. Morphological findings in the chamber angle after ALT include destruction of the uveoscleral meshwork, heat-damaged collagen fibers, and endothelial membrane forma-

tion over the trabecular meshwork (24-28). This endothelial membrane which covers the trabecular meshwork is responsible for the late IOP rise and treatment failure after ALT (24, 26, 28). After low-energy pulsed Nd:YAG laser trabeculoplasty, no such endothelial membrane formation over the trabecular meshwork and thermal damage were observed (26). Recently, the morphologic changes after treatment of the trabecular meshwork in human eye bank eyes with SLT and ALT were compared (29). Evaluation of the trabecular meshwork after ALT revealed crater formation in the uveal meshwork at the junction of the pigmented and nonpigmented trabecular meshwork. Coagulative damage was evident at the base and along the edge of craters, with disruption of collagen beams, fibrinous exudate, lysis of endothelial cells, and nuclear and cytoplasmic debris. Evaluation of the trabecular meshwork after SLT revealed no evidence of coagulative damage or disruption of the corneoscleral, or uveal trabecular beam structure. After SLT minimal evidence of mechanical damage was present, and only ultrastructural evidence of laser tissue cracking of intracytoplasmic pigment granules and the disruption of trabecular endothelial cells. Because both ALT and SLT lower the IOP, it is possible that the SLT produces a selective »biologic effect«, and ALT produces a »biologic and mechanical effect« (29). In the study of Higginbotham et al. (18), PG patients had a greater immediate IOP reduction than the POAG controls to ALT, but failed at a faster rate as compared to POAG. In this study, the mean preoperative IOP was higher in patients with PG (25.5 mm Hg vs. 22.4 mm Hg, $p < 0.08$), which predicts a greater change in pressure after ALT. Pohjanpelto (19) also

reported late failures in the PG group. In the study of Psilas et al. (20), the mean baseline IOP was higher in the PG group than in the POAG group (31.9 mm Hg vs. 28.0 mm Hg). IOP control was obtained in 71% of the PG group and in 81% of the POAG group, with average reduction of IOP for 46% in the PG group and 22% in the POAG group, and a mean follow-up of 22.0 months for the PG group and 25.6 months for the POAG group. Threlkeld et al. (21) also reported a greater initial response to ALT in PG group, the long-term outcome and 3 year success rates (53% in the PG group and 42% in the POAG group) were similar for both groups in a mean follow-up of 23.0 months for the PG group and 27.0 months for the POAG group.

The IOP response of PG and POAG to SLT in our study shows similar mean percent IOP reduction compared to the IOP response of PG and POAG to ALT. There is a slight difference comparing the success rates of ALT and SLT in the PG and the POAG groups, which may be the consequence of the theoretically different mechanism of the ALT and SLT action.

The results of our study demonstrate that SLT is an effective procedure for lowering the IOP in the treatment of uncontrolled PG and POAG, although within 3 years there is a

substantial failure rate in both PG and POAG eyes, and the success seems to decline faster in PG eyes.

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