Efficacy of Selective Laser Trabeculoplasty in Phakic and Pseudophakic Patients with Open-Angle Glaucoma

Sakaorat Petchyim, M.D.*, Naris Kitnarong, M.D.*, Chutima Wongsiwaroj, M.D.**

**Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, **Thainakarin Hospital, 345 Bangna-trad, Bangna, 10260, Thailand.*

ABSTRACT

Objective: To compare the efficacy of selective laser trabeculoplasty (SLT) in terms of intraocular pressure (IOP) reduction between phakic and pseudophakic patients with open-angle glaucoma (OAG).

Methods: Phakic and pseudophakic patients with OAG who had IOP ≥15 mmHg treated with ≥2 topical anti-glaucoma medications were enrolled. Pseudophakic eyes with history of complicated phacoemulsification were excluded. SLT was performed 270 degrees by one surgeon under the same protocol. IOP was measured with applanation preoperatively and at 1 hour, 1 week, 3 weeks and 3 months postoperatively.

Results: There were 59 eyes (38 phakia and 21 pseudophakia) from 38 patients enrolled between September 2011 and August 2012. The mean IOP significantly decreased from 19.5±2.5 and 20.2±3.2 mm Hg preoperatively to 15.6±3.4 and 15.3±3.1 mm Hg postoperatively at 3 months in phakic and pseudophakic group respectively. Mean IOP reduction was not significantly different between phakic (3.9± 3.1 mmHg) and pseudophakic group (5.0±3.06 mmHg, p=0.197). The non-inferiority test indicated that mean IOP reduction in pseudophakic group was non-inferior to phakic group (p=0.012).

Conclusion: SLT was effective for IOP reduction in both phakic and pseudophakic eyes with OAG. The efficacy of SLT in pseudophakic eyes was not inferior to phakic eyes.

Keywords: Selective laser trabeculoplasty; efficacy of selective laser trabeculoplasty; pseudophakic eye; pseudophakia
(Siriraj Med J 2017;69: 70-74)

INTRODUCTION

Glaucoma is the leading cause of irreversible blindness in Thailand and 67% is open-angle glaucoma.[19] The study to investigate the proper treatment is important to prevent people from blindness. Selective laser trabeculoplasty (SLT) is effective and safe in treating the open-angle glaucoma. Although the mechanism of action that results in intraocular pressure reduction is not well established. The factor which could influence the treatment efficacy should be identified.

Phacoemulsification with intraocular lens implantation was hypothesized that it could have negative effect on the efficacy of SLT because SLT and phacoemulsification decrease intraocular pressure by the same pathway. The pathway is the inflammatory cascade which is stimulated at the trabecular meshwork and results in the change in cellular and extracellular matrices which cause the reduction in aqueous outflow resistance.[11,20]

There were few studies which have compared the efficacy of SLT in phakic and pseudophakic eye.[10-14] However, due to the limitations of retrospective nature, the prospective study should be conducted to answer this question.

Correspondence to: Sakaorat Petchyim
E-mail: poy012@yahoo.com
Received 11 November 2016 Revised 14 December 2016 Accepted 20 December 2016
doi:10.14456/smj.2017.14

MATERIALS AND METHODS

This is a prospective comparative study. The study protocol was approved by the Ethics Committee of our institution and followed the tenets of the Declaration of Helsinki (Si 064/2012). We included the patient with open angle glaucoma with IOP (intraocular pressure) ≥15 mmHg who used ≥2 topical anti-glaucoma medications. The participants must be older than 18 years old. The exclusion criteria were patients who underwent intraocular operation or had traumatic ocular event within 6 months period, had uncontrolled uveitis within 3 months period, had complicated cataract surgery, underwent previous laser trabeculoplasty and the patient who could not co-operate during laser treatment as well as those who cannot attend at least 6 month-follow up period. The participants who required intraocular operation during 6 months post laser treatment, poor drug compliance, suffered from serious complication of selective laser trabeculoplasty and decided to exit from the study were withdrawn.

The informed consent were obtained from all the participants who were enrolled. We used the Lumenis Selecta Duet machine and Latina Gonio laser lens which have wavelength 532 nm., pulse duration 3 ns., and spot size 400 microns. The eye examinations were done in all participants which included visual acuity, IOP by using Goldmann applanation tonometry, Gonioscopy and slit lamp examination. If there were no Humphrey visual field and optical coherence topography of optic nerve head within 6 months, the participant must be sent for an examination. Before starting the procedure, 2% pilocarpine was given 1 drop every 5 minutes for 3-4 times until constricted pupil was confirmed. All the laser procedures were done by S.P. The laser power was set at 0.3 mJ and titrated in 0.1 mJ increments until the champagne bubble from pigmented trabecular meshwork were observed. The extent of the treated angle was 270 degrees (approximately 75-90 shots in confluent fashion). The topical steroid eye drop, 1% Prednisolone eye drop, was given every 6 hours for 5 days. One hour post treated IOP were measured and if it was ≥30 mmHg or increase ≥30 % from pre-treatment IOP, the participants were given oral Acetazolamide (250 mg) 1 tab per oral twice a day for 3 days and had to be followed-up within 3 days post treatment. The patients were seen for follow-up 1 week, 1 and 3 months.

The gender, age, underlying disease, type of glaucoma, laterality, lens status and current anti-glaucoma medications including topical and systemic medications were recorded. The eye examination comprised of visual acuity, IOP by Goldmann applanation tonometry, conjunctiva, cornea, anterior chamber, gonioscopy, iris, pupil, lens and disc were examined. Humphrey visual field, optical coherence tomography and central corneal thickness were recorded. In the part of SLT procedure, laser parameters including power (mJ), number of spots, and total energy were recorded. Treated angle was recorded in gonioscopic view. Immediate post-laser complication, with pre- and post-op medications were noted. For the follow-up visit, the participants were asked about abnormal symptom and examined for visual acuity, IOP, conjunctiva, cornea, and anterior chamber. The gonioscopic exam was done on the 3rd month visit in order to find new PAS formation. Current anti-glaucoma medications were recorded every visit.

The eye was categorized in phakic and pseudophakic by mean of lens status. Pseudophakic patient had to undergo successful clear cornea phacoemulsification with intraocular lens implantation. IOP reduction was determined at 1st month and 3rd month visits. Glaucoma severity which was 5 years risk to progression were determined in order to define what was the target IOP for each particular eye, based on Asia Pacific Glaucoma Guideline, SEAGIG 2nd edition. Success was defined by 2 criteria, first was IOP reach target and the second was IOP reduction ≥3 mmHg at 3rd month visit. We compared age, gender, laterality, glaucoma diagnosis, baseline IOP, number of baseline medications and 5 years risk to progression and laser parameters in phakic and pseudophakic groups. In addition, mean IOP reduction from baseline IOP at 3rd month visit and success rate in both criteria were compared between two groups. By adding the new medication or undergoing glaucoma surgery within 3 months after SLT treatment was classified into failure group. SPSS version 15.0 (SPSS Inc., Chicago, IL) was used to analyzed the data. We used the student t test to compare means of numerical data in both groups after it was confirmed to be normal distribution by using Kolmogorov-Smirnov test. Demographic data and success rate was compared with λ^2 test. The mean IOP reduction was compared between the groups by using non-inferiority test.

RESULTS

There were 60 eyes of 39 patients who completed 3 months follow-up but 1 patient was withdrawn because of poor drug compliance. Finally, we analyzed 59 eyes of 38 patients with open-angle glaucoma, of which 38 eyes were phakia and 21 eyes were pseudophakia.

The mean age was 60.3±9.9 years in phakic group and 71.1±7.4 years in pseudophakic group (p=0.001). Most of the patients were diagnosed as primary open-

angle glaucoma, 1 eye in each group was diagnosed with combined mechanism glaucoma and 1 eye in pseudophakic group was diagnosed with pigmentary glaucoma. In terms of 5 years risk to progression which reflects severity of glaucoma, there was no statistical different between the groups (p=0.071). Also the mean IOP at baseline and number of anti-glaucoma medications were not statistically different. The demographic data were shown in Table 1. As shown on the table, the mean number of anti-glaucoma medications was 3.4±0.7 and 3.2±0.9 in phakic and pseudophakic groups, respectively. This could be explained by, SLT was used mostly for adjunctive treatment in the patient who could not tolerate anti-glaucoma medication, could not reach target IOP after treating with medication and needed to postpone surgery. The average of spot number and sum of energies were not statistically different between the groups as shown in Table 2.

TABLE 1. Baseline demographic data.

Characteristics	Phakic N=38 eyes	Pseudophakic N=21 eyes	p value
Male	21 (55.3%)	8 (38.1%)	0.742
Right eye	12 (54.5%)	10 (62.5%)	0.645
Age			
Mean ±SD (years)	60.3±9.9	71.1±7.4	0.001
Type of glaucoma			
POAG	36	18	0.475
Pigmentary glaucoma	0	1	
Combined mechanism glaucoma	2	2	
Baseline IOP			
Mean ±SD (mmHg)	19.7±2.7	19.9±3.3	0.806
Number of medication	3.4±0.7	3.2±0.9	0.759
5-year risk to progress*			
High risk	27.3%	56.3%	0.071
Moderate risk	72.7%	43.8%	

*Asia Pacific Glaucoma Guideline, SEAGIG 2nd edition

TABLE 2. Laser parameters.

Laser parameter	Phakic	Pseudophakic	p value
Spot number	74.5±16.5	76.4±21.1	0.761
Sum of energy (mJ)	53.6±19.1	52.7±17.5	0.854

TABLE 3. Success rate at 3rd month follow-up.

	Phakic	Pseudophakic	p value
5 years risk to progress			
High risk	27.3%	56.3%	0.071
Moderate risk	72.7%	43.8%	
Success rate : criteria 1*	59.1%	68.8%	0.542
Success rate : criteria 2**	81.8%	68.8%	0.350

*Criteria 1 is "reach target IOP" from Asia Pacific Glaucoma Guideline, SEAGIG 2nd edition. Based on 5 years risk to progress: high risk 11-13 mmHg, moderate risk 14-16 mmHg.
**Criteria 2 is "IOP reduction ≥3 mmHg"

Mean baseline IOP was 19.7±2.7mm Hg in phakic group while mean baseline IOP was 19.9±3.3 mm Hg in pseudophakic group which was not significantly different (p=0.806). The mean IOP reduction at 3rd month visit was 3.9±2.8 mm Hg in phakic group, whereas the mean IOP reduction in pseudophakic group was 4.6±3.4 mm Hg in which there was no statistical difference between the 2 study groups (p=0.014, -1.3 to 2.7).

The success rate by criteria 1 which used percentage of the eye that reached target IOP was determined by 5 years risk to progression which was 59.1% and 68.8% in phakic and pseudophakic eyes, respectively (p=0.542). By the success criteria 2 which used percentage of the eyes that reached ≥3 mm Hg IOP, reduction from baseline was 81.8%, and 68.8% in phakic and pseudophakic eyes, respectively (p=0.350). There were no patients who received the additional medication or underwent glaucoma surgery after SLT during the period of 3 months follow-up. There were 2 eyes (5%) in phakic group which had IOP spike (IOP increase ≥5 mmHg in 1 hour post laser treatment) and these were treated with 3 days dose of oral acetazolamide without sustained IOP rising. One patient reported an ocular discomfort, but it was mild, and not related with any serious complication. None of the eyes in both groups developed PAS after SLT.

DISCUSSION

Selective laser trabeculoplasty (SLT) was proven for its effectiveness in IOP reduction as an adjunctive treatment and primary treatment in open angle glaucoma. Compared to argon laser trabeculoplasty and medication, the efficacy is not inferior to others measured by the results of RCTs.1-7 SLT also showed a tendency for a good efficacy and safety in repeatable manner.[8,9] There were only a few reports which studied about efficacy of SLT in pseudophakic compare to phakic eyes, and all of these were retrospective chart review.[10-14] Although there were some studies about the prediction factor for success rate of SLT, the result was no effect of pseudophakic status on the efficacy of SLT,[15,16] and there was no prosepective study designed to compare the efficacy of SLT in phakic and pseudophakic eyes. To the best of our knowledge this was the first prospective interventional study which aimed to compare the efficacy of SLT in phakic and pseudophakic eyes.

From the result, baseline characteristics were not different between the groups as well as laser parameters and total energy. The older age in pseudophakic group just reflected the aging process of the cataract. Our study revealed that SLT efficacy in pseudophakic eye was not inferior to that in phakic eye in terms of mean IOP change from baseline and success rate by 2 criteria as mentioned above. This was similar to previous studies.[10-14] The mean IOP reduction at 3 months in pseudophakic group after treatment was comparable with the previous RCTs studies.[7] The success rate in our study was determined by different criteria from other studies, so it could not be compared. The reason was to mimic the real life clinical management in glaucoma in which the IOP reduction was not the only factor that we were concerned. The patient who reached the target pressure set for a particular patient was what we classified as the success of the treatment. The complications from the treatment were not different from previous studies[18] and were easily manageable with no long term complications. The weak points of this paper were short follow-up period and small sample size.

In conclusion, SLT for pseudophakic and phakic eyes were effective in terms of IOP reduction and success rate in treating open angle glaucoma. From our study, the efficacy of SLT in pseudophakic eyes with open angle glaucoma was not inferior to phakic eyes.

Conflict of interests

All authors declare no conflicts of interests.

REFERENCES

1. Bovell AM, Damji KF, Hodge WG, Rock WJ, Buhrmann RR, Pan YI. Long term effects on the lowering of intraocular pressure: selective laser or argon laser trabeculoplasty. Can J Ophthalmol 2011; 46: 408-13.
2. Kent SS, Hutnik CM, Birt CM, Damji KF, Harasymowycz P, Si F, et al. A randomized clinical trial of selective laser trabeculoplasty versus argon laser trabeculoplasty in patients with pseudoexfoliation. J Glaucoma 2015; 24: 344-7.
3. Lai JS, Chua JK, Tham CC, Lam DS. Five-year follow up of selective laser trabeculoplasty in Chinese eyes. Clin Experiment Ophthalmol 2004; 32: 368-72.
4. Katz LJ, Steinmann WC, Kabir A, Molineaux J, Wizov SS, Marcellino G, et al. Selective laser trabeculoplasty versus medical therapy as initial treatment of glaucoma: a prospective, randomized trial. J Glaucoma 2012; 21: 460-8.
5. Nagar M, Luhishi E, Shah N. Intraocular pressure control and fluctuation: the effect of treatment with selective laser trabeculoplasty. Br J Ophthalmol 2009; 93: 497-501.
6. Nagar M, Ogunyomade A, O'Brart DP, Howes F, Marshall J. A randomised, prospective study comparing selective laser trabeculoplasty with latanoprost for the control of intraocular pressure in ocular hypertension and open angle glaucoma. Br J Ophthalmol 2005; 89: 1413-7.
7. Rosenfeld E, Shemesh G, Kurtz S. The efficacy of selective laser trabeculoplasty versus argon laser trabeculoplasty in pseudophakic glaucoma patients. Clin Ophthalmol 2012; 6: 1935-40.
8. Avery N, Ang GS, Nicholas S, Wells A. Repeatability of primary selective laser trabeculoplasty in patients with primary open-angle glaucoma. Int Ophthalmol 2013; 33: 501-6.

9. Hong BK, Winer JC, Martone JF, Wand M, Altman B, Shields B. Repeat selective laser trabeculoplasty. J Glaucoma 2009; 18: 180-3.
10. Werner M, Smith MF, Doyle JW. Selective laser trabeculoplasty in phakic and pseudophakic eyes. Ophthalmic Surg Lasers Imaging 2007; 38: 182-8.
11. Shazly TA, Latina MA, Dagianis JJ, Chitturi S. Effect of prior cataract surgery on the long-term outcome of selective laser trabeculoplasty. Clin Ophthalmol 2011; 5: 377-80.
12. Mahdaviani S, Kitnarong N, Kropf JK, Netland PA. Efficacy of laser trabeculoplasty in phakic and pseudophakic patients with primary open-angle glaucoma. Ophthalmic Surg Lasers Imaging 2006; 37: 394-8.
13. Bovell AM, Damji KF, Hodge WG, Rock W, Buhrmann R, Pan Y. Selective laser trabeculoplasty vs Argon laser trabeculoplasty response in phakic and pseudophakic patients. Invest Ophthalmol Vis Sci 2005; 46: 112.
14. Seymenoglu G, Baser EF. Efficacy of selective laser trabeculoplasty in phakic and pseudophakic eyes. J Glaucoma 2015; 24: 105.
15. Martow E, Hutnik CM, Mao A. SLT and adjunctive medical therapy: a prediction rule analysis. J Glaucoma. 2011; 20: 266–270.
16. Tzimis V, Tze L, Ganesh J, Muhsen S, Kiss A, Kranemann C, et al. Laser trabeculoplasty: an investigation into factors that might influence outcomes. Can J Ophthalmol 2011; 46: 305-9.
17. Rhodes KM, Weinstein R, Saltzmann RM, Aggarwal N, Kooner KS, Petroll WM, et al. Intraocular pressure reduction in the untreated fellow eye after selective laser trabeculoplasty. Curr Med Res Opin 2009; 25: 787-96.
18. Wong MO, Lee JW, Choy BN, Chan JC, Lai JS. Systematic review and meta-analysis on the efficacy of selective laser trabeculoplasty in open-angle glaucoma. Surv Ophthalmol 2015; 60: 36-50.
19. Bourne RR, Sukudom P, Foster PJ, Tantisevi V, Jitapunkul S, Lee PS, et al. Prevalence of glaucoma in Thailand: a population based survey in Rom Klao District, Bangkok. Br J Opthalmol 2003; 87: 1069-74.
20. Bhallil S, Andalloussi IB, Chraibi F, Daoudi K, Tahri H. Changes in intraocular pressure after clear cornea phacoemulsification in normal patients. Oman J Ophthalmol 2009; 2: 11-3.