# Long-Term Intraocular Pressure Change after Clear Corneal Phacoemulsification in Thai Glaucoma Patients

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***Objectives:*** *To evaluate long-term intraocular pressure (IOP) changes after sutureless clear corneal phacoemulsification in eyes with preoperatively controlled glaucoma.*
***Design:*** *Retrospective study.*
***Setting:*** *Eye clinic, Ramathibodi Hospital, Faculty of Medicine, Mahidol University.*
***Material and Method:*** *The medical records of 218 patients who had uneventful sutureless clear corneal phacoemulsification with acrylic foldable lens (IOL) implantation were retrospectively reviewed. Included were 58 patients with medically controlled open-angle glaucoma and 160 normal controls. Follow-up was 12 to 18 months. Outcome measures were postoperative IOP and number of glaucoma medications.*
***Results:*** *Postoperatively, there was an insignificant decrease in IOP in the glaucoma group; the mean decrease was 1.4 mm Hg $\pm$ 3.8 (SD) at 12 months and 1.6 $\pm$ 4.2 mm Hg at 18months. The mean number of medications decreased significantly at 12 months (0.51 $\pm$ 0.75) and at 18 months (0.41 $\pm$ 0.83) (P = .04). The control group also had a significant decrease in IOP, with a mean decrease of 0.83 $\pm$ 2.8 mm Hg at 12 months (P = .01) and 1.26 $\pm$ 2.9 mm Hg at 18 months (P < .0001). The decrease in IOP was more pronounced in eyes with a higher preoperative IOP in both the glaucoma and control groups.*
***Conclusion:*** *These findings suggest that sutureless clear corneal phacoemulsification with foldable acrylic IOL implantation is a relatively safe and simple surgical option in patients with cataract and well-controlled glaucoma. The approach provided favorable long-term IOP change and led to rapid visual rehabilitation in both the glaucoma and control group.*

***Keywords:*** *Intraocular pressure, Phacoemulsification, Glaucoma*

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Previous studies[1-3] demonstrated that intracapsular and extracapsular cataract extraction improved glaucoma control by reducing (IOP), and the number of required glaucoma medications, or both. Although the relationship between cause and effect has often been observed, the nature by which cataract surgery influences IOP is not fully understood. Possible mechanisms include decreased resistance to aqueous humor outflow due to anterior chamber angle widening and biochemical or blood-aqueous barrier (BAB) alteration.

Today, phacoemulsification represents state-of-the-art cataract surgery. This technique uses small incisions and foldable intraocular lenses (IOLs), which eliminate the need for sutures and greatly reduce trabecular meshwork distortion. In patients with glaucoma, phacoemulsification can cause less damage to an already compromised outflow facility.

Recent studies[4,5] report IOP reduction after phacoemulsification in normal and glaucomatous eyes. Each study, however, used diverse surgical techniques and different IOLs. Modern phacoemulsification uses a sutureless clear corneal incision and a foldable acrylic IOL.

The present study evaluated long-term IOP changes after sutureless clear corneal phacoemulsification with in-the-bag implantation of foldable acrylic posterior chamber IOLs in eyes with preoperatively controlled glaucoma. The results were compared with

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those in eyes without glaucoma that underwent the same procedure. The long-term IOP response to phacoemulsification in eyes with glaucoma and cataract should serve as a guide to clinicians in the management of these patients.

## Material and Method

The charts of 218 patients who had uneventful sutureless clear corneal phacoemulsification with in-the-bag foldable posterior chamber acrylic IOL implantation at the Department of Ophthalmology, Ramathibodi Hospital from January 1, 2002 to December 31, 2003, were retrospectively reviewed. All patients had visually significant cataract requiring surgery. Fifty-eight patients had open-angle glaucoma (glaucoma group), and 160 patients had no glaucoma (control group). Glaucoma was diagnosed with the glaucomatous visual field defect and/or the glaucomatous optic disc changes irrespective of IOP level.

Excluded were patients with narrow iridocorneal angle, angle closure glaucoma, and previous intraocular surgery. All glaucoma patients were receiving glaucoma medications that adequately controlled IOP.

### *Surgical Technique*

All surgeries were performed by a single surgeon (Y-L) using the same technique. Eyes were prepared for surgery by instilling tropicamide 0.5% for pupil dilation and benoxinate 0.4% for topical anesthesia.

Surgery consisted of a 3.0 mm temporal clear corneal tunnel incision, injection of viscoelastic material into the anterior chamber, capsulorhexis, hydrodissection, in-the-bag phacoemulsification using the phaco-chop technique, cortex aspiration, injection of viscoelastic material, and insertion of a foldable acrylic IOL in the capsular bag. The viscoelastic material was then removed. The corneal incision was closed by stromal hydration.

Postoperatively, all patients were treated with prednisolone acetate 1% eye-drop 3 times daily for 1 week, after which the dose was gradually tapered. There was no difference in the postoperative steroid therapy between the glaucoma group and control group. Postoperative antiglaucoma therapy was administered to maintain IOP within levels of acceptable glaucoma control based on 2 consecutive measurements performed at separate visits. Each patient's preoperative glaucoma medications were initially discontinued and then reinitiated as necessary to maintain the IOP within levels of target pressure.

Information recorded from preoperative visits included applanation tonometry in both groups and glaucoma medications in the glaucoma group. Patients were examined at the end of the follow-up period (12 or 18 months after surgery), and the same variables were recorded.

### *Statistical analysis*

The intra-individual differences in the 2 groups in preoperative and postoperative IOPs were analyzed by the paired-Student t-test. The mean changes in IOP after surgery between the glaucoma group and control group were analyzed by unpaired t-test. The intra-individual differences between preoperative and postoperative number of glaucoma medications in the glaucoma group were analyzed by the paired-Student t-test. P value less than 0.05 was considered significant.

## Results

In the glaucoma group, 58 patients (28 men, 30 women) were available at the 12-month follow-up and 54 patients (28 men, 26 women) were available at the 18-month follow-up; the mean age of the patients was $75 \pm 7$ years and $73 \pm 5$ years, respectively. In the control group, 160 patients (70 men, 90 women) were available at the 12-month follow-up and 151 patients (66 men, 85 women) were available at the 18-month follow-up; the mean age was $68 \pm 8$ years and $70.5 \pm 6$ years, respectively. Glaucoma patients were older than control patients.

### *Glaucoma Group*

In the glaucoma group, there was no significant difference in the mean preoperative IOP (baseline) between 12-month follow-up group and 18-month follow-up group (Table 1). After phacoemulsification, the mean postoperative IOP was lower than the respective preoperative value at 12 months and 18 months, although the difference was not statistically significant ($P = 0.055$ and $P = 0.070$, respectively). The mean decrease in IOP at 12 months was $1.4 \pm 3.8$ mm Hg (95% confidence interval, -0.06 to 2.95) and at 18 months, $1.6 \pm 4.2$ mm Hg (95% confidence interval, -0.16 to 3.97). The mean percentage change from baseline was 8.5% at 12 months and 9.5 % at 18 months. The difference between 12 months and 18 months was not statistically significant ($P = 0.70$).

The mean number of preoperative glaucoma medications in patients with a 12-month follow-up was

**Table 1.** Pre- and postoperative IOP and number of antiglaucoma medications

| | Control Group (N = 160) | | Glaucoma Group (N = 58) | |
|---|---|---|---|---|
| Parameter | 12 m FU (n = 160) | 18 m FU (n = 151) | 12 m FU (n = 58) | 18 m FU (n = 54) |
| Preoperative IOP (mmHg) | 14.5±4.1 | 14.8±3.3 | 16.5±3.8 | 16.8±4.5 |
| Postoperative IOP (mmHg) | 13.7±3.4 | 13.5±2.8 | 15.1±2.5 | 15.2±3.7 |
| Preoperative medications (n) | NA | NA | 1.2±0.58 | 1.4±0.8 |
| Postoperative medications (n) | NA | NA | 0.69±0.63 | 0.99±0.95 |

FU = follow-up; IOP = intraocular pressure; n = number; NA = not applicable

not significantly different from the mean in patients with an 18-month follow-up (Table 1). All patients in the group required medications to control IOP preoperatively. After phacoemulsification, the mean number of medications required to control glaucoma decreased significantly in both follow-up groups. The mean decrease at 12 months was 0.51 ± 0.75 (P = 0.04) and at 18 months, 0.41 ± 0.84 (P = 0.04). After phacoemulsification, 42% of patients in the 12-month group and 35% of patients in the 18-month group required no medication.

***Control Group***

In the control group, there was no significant difference in the mean preoperative IOP (baseline) between 12-month follow-up group and 18-month follow-up group (Table 1). After phacoemulsification, the mean postoperative IOP was significantly lower than the respective preoperative value at 12 months and 18 months. The mean decrease in IOP at 12 months was 0.83 ± 2.8 mm Hg (P = 0.01) and at 18 months, 1.26 ± 2.9 mm Hg (P < .0001). The mean percentage change from baseline was 5.7% at 12 months and 8.5% at 18 months. The difference between the 12-month and 18-month was 2.8% different.

***Both Groups***

The baseline IOP was significantly lower in the control group than in the glaucoma group at 12 months (P < 0.01) and 18 months (P < 0.02). The IOP-lowering effect of phacoemulsification at both follow-ups was not significantly different between the 2 groups.

The decrease in IOP after phacoemulsification was more pronounced in eyes with a higher preoperative IOP in the glaucoma group (at 12 months: P < .0001; at 18 months) and the control group (P < 0.0001 and P < 0.0001, respectively).

**Discussion**

The data from the present study support a benefit of sutureless clear corneal phacoemulsification with foldable acrylic IOL implantation in patients with cataract and medically controlled glaucoma. The mean postoperative IOP at 12 months and 18 months was lower than the respective preoperative values, and the mean percentage change from baseline was clinically significant. The change in IOP was not significant, probably because of the small number of patients and the change in type of medications. The authors also found a significant decrease in IOP after surgery in patients who did not have glaucoma preoperatively. In the present study, the mean postoperative IOP at 12 and 18 months was lower than the respective preoperative values and the mean percentage change from baseline was significant at both follow-ups. The decrease in IOP at 12 and 18 months was greater in the control patients and glaucoma patients who had a higher IOP preoperatively. This suggests that preoperative borderline-controlled IOP may be better controlled after surgery.

In addition, significantly fewer glaucoma medications were required postoperatively (0.51 at 12 months and 0.41 at 18 months) than preoperatively. Medications were eliminated in 42% of eyes at 12 months and 35% at 18 months. The decrease in the number of medications reduced treatment side effects and increased patient compliance. The clinical importance of this cannot be overemphasized.

The present findings concur with findings in previous studies that documented improvement in glaucoma control after phacoemulsification[5-9]. The postoperative IOP course may be influenced by the procedure. Each study, however, has several surgeons, used diverse surgical techniques with a different IOL. The nonstandardized surgical technique in these studies may have biased the results. Therefore, these

studies are not directly comparable to the present study, in which a single surgeon and one phacoemulsification technique (sutureless clear corneal incision and foldable acrylic IOL) was used.

In a study that may be comparable to the present study, Kim et al found a greater than 3 mm Hg drop in IOP with the same medications or a decrease in medications with the same IOP in 28 of 31 eyes with glaucoma 16 months after phacoemulsification. They used the same surgical technique and inserted a foldable IOL, as in the present study. There were fewer patients (31 eyes) and a shorter follow-up (16 months) in their study than in the present study. Furthermore, their study did not include a control group (patients without glaucoma) for comparison. Another study comparable is that by Shingleton et al[9], who compared IOP and medication reduction after temporal clear corneal phacoemulsification with foldable silicone IOL insertion in glaucoma patients, glaucoma suspects, and normal controls. They found a significant reduction in IOP in all groups at 6 months and in the control group and glaucoma-suspect group at 12 months. There was also a significant decrease in the number of glaucoma medications, although not in IOP, at 12 months in the glaucoma group. Follow-up was limited to 12 months. The importance of a longer follow-up is demonstrated by the loss of statistical significance in IOP reduction in glaucoma patients from 6 to 12 months in their study, indicating the added power of the present study, in which the last follow-up was at 18 months.

The authors found a decrease in IOP after phacoemulsification in patients without preexisting ocular disease; This has been reported in other studies [4,7,10-12]. The authors compared the postoperative decrease in IOP in eyes with glaucoma and in eyes without glaucoma. The reduction in IOP in the 2 groups at 12 and 18 months after phacoemulsification was not statistically different. The small group of glaucoma patients is a drawback of the present study. A larger sample might have shown statistically significant postoperative IOP reduction.

The endogenous prostaglandin F2 released postoperatively is thought to enhance uveoscleral outflow. Other possible mechanisms are a decrease in secretion of aqueous humor, promoted by increased traction on the ciliary body via the zonular fibers as a result of postoperative shrinkage of the lens capsule or of biomechanical or BAB alterations after surgery[13,14].

The present study suggests that sutureless clear corneal phacoemulsification with foldable acrylic IOL implantation is a reasonable surgical option in patients with coexisting cataract and moderately well-controlled glaucoma. This approach has an important advantage i.e. long-term IOP control is maintained with fewer medications. Decreasing the number of medications needed for glaucoma control improves the patient's quality of life, encourages compliance, and reduces the cost of treatment, an increasingly important factor in cost-conscious health situation in a developing country.

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## *การเปลี่ยนแปลงในระดับความดันลูกตาของคนไทยภายหลังการสลายต้อกระจก*

***ยุพิน ลีละชัยกุล, อัทยา อยู่สวัสดิ์***

***วัตถุประสงค์:*** *เพื่อศึกษาการเปลี่ยนแปลงในระดับความดันลูกตาของผู้ป่วยโรคต้อหินชาวไทย ภายหลังได้รับการสลายต้อกระจก โดยวิธี Sutureless clear corneal approach*

***รูปแบบการทำวิจัย:*** *การศึกษาย้อนหลัง*

***สถานที่ทำวิจัย:*** *คลินิกผู้ป่วยนอกจักษุ คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล*

***วัสดุและวิธีการ:*** *ข้อมูลจากบันทึกประวัติผู้ป่วย 218 ราย ที่ได้รับการสลายต้อกระจกโดยวิธี Sutureless clear corneal approach และใส่เลนส์แก้วตาเทียมชนิดพับได้ แบ่งเป็นกลุ่มผู้ป่วยต้อหินชนิดมุมเปิดที่รักษาด้วยยารวม 58 ราย และกลุ่มที่ไม่ได้เป็นต้อหินรวม 160 ราย โดยระยะการติดตามผู้ป่วยทั้งสิ้น 12 ถึง 18 เดือน โดยศึกษาการเปลี่ยนแปลงในระดับความดันลูกตา และจำนวนชนิดของยาต้อหินที่ผู้ป่วยใช้ภายหลังได้รับการผ่าตัด*

***ผลการวิจัย:*** *ภายหลังการผ่าตัดสลายต้อกระจก 12 เดือน พบว่าระดับความดันลูกตาในผู้ป่วยต้อหินลดลงเฉลี่ยเพียง 1.4 $\pm$ 3.8 มม. ปรอท และลดลง 1.6 $\pm$ 4.2 มม. ปรอท ที่ 18 เดือน (ไม่มีนัยสำคัญทางสถิติ) แต่จำนวนของยาต้อหินที่ใช้เฉลี่ยลดลงอย่างมีนัยสำคัญทั้งที่ 12 และ 18 เดือน (0.51 $\pm$ 0.75 และ 0.41 $\pm$ 0.83 ตามลำดับ และ P = .04) แต่ในกลุ่มผู้ป่วยที่ไม่ได้เป็นต้อหินพบว่าระดับความดันลูกตาลดลงอย่างมีนัยสำคัญทั้งที่ 12 และ 18 เดือน (0.83 $\pm$ 2.8 มม. ปรอท, P = .01 และ 1.26 $\pm$ 2.9 มม. ปรอท, P < .0001) โดยระดับความดันลูกตาที่ลดลงจะมากขึ้นในตาที่มีระดับความดันลูกตาสูงกว่าก่อนได้รับการผ่าตัด ทั้งในผู้ป่วยที่เป็นและไม่เป็นต้อหิน*

***สรุป:*** *การสลายต้อกระจกโดยวิธี Sutureless clear corneal approach และใส่เลนส์แก้วตาเทียมชนิดพับได้เป็นวิธีการผ่าตัดที่ปลอดภัยในกลุ่มผู้ป่วยต้อหินที่ควบคุมได้ด้วยยา และมีภาวะต้อกระจกร่วมด้วย โดยระดับความดันลูกตาจะลดลง และอยู่ในระดับที่ปลอดภัยทั้งในผู้ป่วยที่เป็นและไม่เป็นต้อหิน*