วารสารแพทย์เขต ๔-๕ ปีที่ ๓๑ ฉบับที่ ๓ ก.ค. - ก.ย. ๒๕๕๕ Reg 4-5 Med J Vol. 31 No. 3 July - September 2012

นิพนธ์ต้นฉบับ **Original Article**

Central Corneal Thickness Change after Phacoemulsification: a Prospective Study

การศึกษาความหนาของกระจกตาที่เปลี่ยนแปลงหลังผ่าตัดสลายต้อกระจก

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ABSTRACT

Objectives: To study the change of central corneal thickness after phacoemulsification and its effect on post-operative intraocular pressure and visual outcomes

Material and Methods: Prospective data collection was done on patients whom received cataract phacoemulsification, by sole ophthalmologist, on the never-operated eyes. Demographic data, central corneal thickness (CCT), intraocular pressure (IOP) of both eyes and visual acuity (VA) of operated eyes were recorded at pre-operation, day 1 and day 7 post-operation.

Compared the data of operated eyes between pre-operation, as baseline, against day 1 post-operation and pre-operation against day 7 post-operation to find the change of CCT and its adverse effects on IOP and VA.

Results: A total of 46 patients, with the mean (S.D.) age of 60.70 (10.2) years, were enrolled. The mean (S.D.) CCT of operated eyes at baseline was 537.04 (34.77). It significantly increased on day 1 post-operation and decreased to pre-operative condition on day 7. The IOP remained unchanged throughout the study period. The VA was improved on day 1 after surgery and improved further on day 7 post-operation.

Conclusions: Post phacoemulsification CCT change was reversible adverse reaction and returned to baseline condition in just a single week relatively to visual outcomes. Meanwhile, IOP was not effected by this alteration.

Keywords: postoperative corneal edema, central corneal thickness, corneal endothelial cell, phacoemulsification

บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาการเปลี่ยนแปลงความหนาของกระจกตาหลังผ่าตัดสลายต้อกระจก และศึกษาว่าการเปลี่ยนแปลงนี้จะมีผลข้างเคียงต่อความดันลูกตาและการมองเห็นหลังผ่าตัดหรือไม่ อย่างไร

วัสดุและวิธีการ: เป็นการเก็บข้อมูลแบบไปข้างหน้าในผู้ป่วยได้รับการผ่าตัดสลายต้อกระจกโดยจักษุแพทย์เพียง 1 ท่าน ผู้ป่วยได้รับการผ่าตัดในตาที่ไม่เคยได้รับการผ่าตัดใดมาก่อน โดยจะทำการบันทึกข้อมูลประชากรทั่วไป ความหนาของกระจกตา ความดันลูกตาทั้งสองข้าง ระยะการมองเห็นของตาที่ได้รับการผ่าตัด ในวันก่อนผ่าตัด 1 วัน และ 7 วันหลังผ่าตัด

นำข้อมูลที่ได้ของลูกตาที่ทำผ่าตัดมาเปรียบเทียบกันระหว่างก่อนผ่าตัด กับวันที่ 1 หลังผ่าตัด และระหว่างก่อนผ่าตัด กับวันที่ 7 หลังผ่าตัด เพื่อทำการวิเคราะห์ดูการเปลี่ยนแปลงของความหนาของกระจกตา ความดันลูกตา และระดับสายตาหลังผ่าตัด

ผลการศึกษา: มีผู้ป่วยเข้าในการศึกษาทั้งสิ้น 46 คน อายุเฉลี่ย 60.70 ± 10.12 ปี ค่าเฉลี่ยความหนาของกระจกตาเพิ่มขึ้นอย่างชัดเจนหลังทำผ่าตัดวันแรก แต่ยุบลงและกลับเป็นปกติในวันที่ 7 ระยะการมองเห็นจะดีขึ้นทันทีหลังผ่าตัด และดีขึ้นจนน่าพอใจในวันที่ 7 ในระยะเวลาดังกล่าวไม่พบว่ามีความดันลูกตาเพิ่มขึ้น

สรุป: การเปลี่ยนแปลงความหนาของกระจกตาหลังผ่าตัดเป็นผลข้างเคียงจากการผ่าตัดที่กลับมาใกล้เคียงปกติได้ในระยะเวลา 1 สัปดาห์สัมพันธ์กับการมองเห็นที่ดีขึ้นในช่วงเวลาดังกล่าว และการเปลี่ยนแปลงดังกล่าวไม่มีผลต่อความดันลูกตา

คำสำคัญ: กระจกตาบวมหลังผ่าตัด ความหนาของกระจกตา เซลล์ผิวกระจกตา การสลายต้อกระจก

Introduction

Cataract is the most common cause of reversible visual loss. Phacoemulsification has been used widely to tackle the condition. By this technique, the opaque lenses are removed by a high power ultrasonic instrument. Heat production around the ultrasonic probe tip, solution irrigation in the anterior chamber, mechanical damage from lens material, and instrumental injury inevitably bear some effects on the corneal endothelium and may variably cause corneal change after operation.[1-3]

Corneal endothelial cells are especially sensitive to surgical damage. Alterations of endothelium and CCT are crucial parameters to monitor surgical trauma and therefore are utilized for evaluating the safety of new surgical method.[4-6] The objectives of this research is to study the clinical course of CCT change after phacoemulsification and its effects on the IOP and visual outcomes.

Material and Methods

This study protocol was approved by ophthalmology division Nakhonpathom hospital and all subjects gave consent before procedures.

From March 1st to May 31st, 2012, 46 patients with their cataract phacoemulsification were enrolled in this prospective study. After medical and ophthalmologic evaluation, patients with uncontrollable DM, HT, unable to hold anticoagulant, previous eye surgery and any eye problems other than cataract,

were excluded.

Only one ophthalmologist performed the operations with topical anesthesia, clear cornea technique, no suture and patched the eyes with Tobrex ointment.

Data recorded from recruited subjects included CCT and IOP of both eyes and the VA of operated eyes at pre-operation, day 1 and day 7 post-operation. The CCT of both eyes were measured but the CCT of only the operated eyes were used for comparison. The CCT at baseline (pre-operation) was compared against the day 1 and day 7 post-operation by paired t-test. A p-value of 0.05 was considered statistically significant.

In the same way of CCT, the IOP values were also done. And VA of operated eyes were gathered to demonstrate their post-operative change.

Results

There were 46 cataract phacoemulsifications in this study, average age of 60.70 ± 10.12 years and male: female 26: 20.

Mean CCT of both eyes were shown in Table 1 and Figure 1.

Compared operated CCT values between pre-operation (as baseline) against post operation with paired t-test to evaluate whether they had statistical significant change. In Table 1.1 on day 1

Table 1 Mean CCT of operated and non operated eyes.

Mean CCT	Pre-operative	Day 1	Day 7
Operated eyes	537.04 ± 34.77	579.37 ± 37.68	537.33 ± 33.10
Non operated eyes	531.82 ± 34.60	532.13 ± 35.42	525.34 ± 34.65

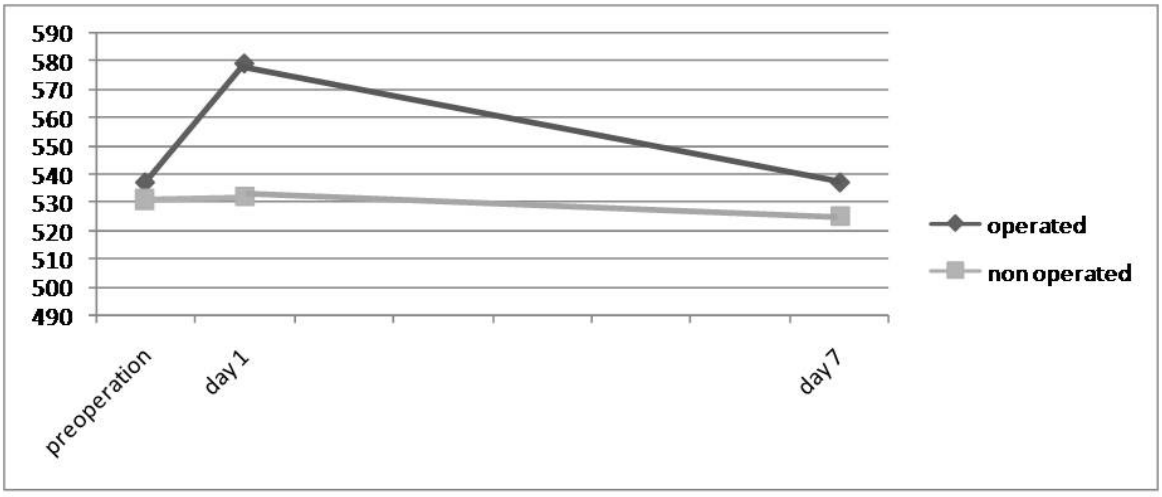

Figure 1 Progression of mean CCT in operated and non operated eyes (in graft)

post-operation showed strong statistical significance (p-value = 0.0001) but on day 7 post-operation did not show statistical significant difference (p-value = 0.8722).

Mean IOP results of both eyes were demonstrated in Table 2 and Figure 2. All of them were in normal limited pressure .

Compared IOP of operated eyes between pre-operation against day 1 post-operation and pre-operation against day 7 post-operation to find any alteration of IOP by paired t-test analysis. As shown in Table 2.1 there was no statistical significance on both day 1 (p-value = 0.6616) and day 7 (p-value = 0.2960).

Table 1.1 Pre and post-operative CCT statistic comparison

Pre-operative CCT (baseline)	Post-operative CCT	P- value*
3537.04 ± 34.77	Day 1 579.37 ± 37.68	0.0001
537.04 ± 34.77	Day 7. 537.33 ± 33.10	0.8722

*chi square test

Table 2 IOP of operated and the other eyes.

IOP	Pre-operative	Day 1	Day 7
Operated eyes	13.009 ± 3.38	12.804 ± 4.25	12.576 ± 3.65
Non operated eyes	12.38 ± 3.85	12.56 ± 3.15	12.92 ± 3.04

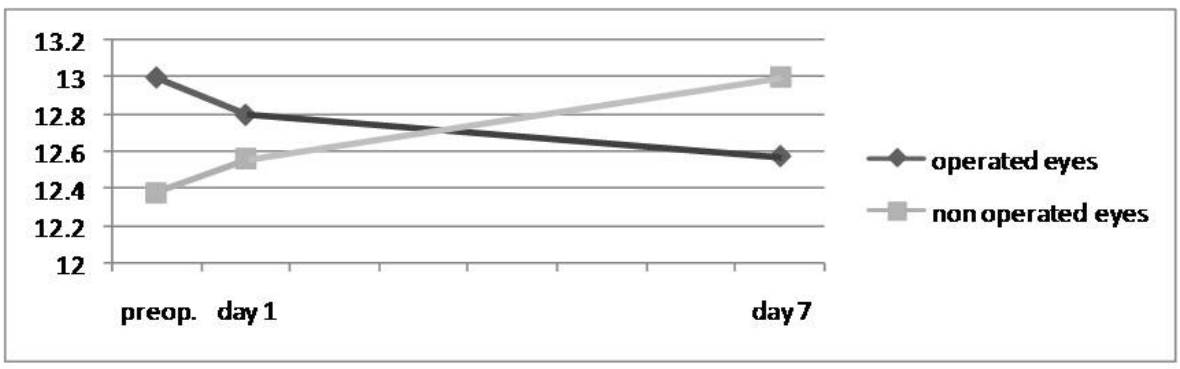

Figure 2 Progression of mean IOP of both eyes.

Visual acuity outcomes of operated eyes at pre-operation and post-operation were shown in Table 3.

Discussion

Post-operative CCT increasing indicates alteration of endothelial cell function. Corneal endothelial cells are crucial to corneal transparency and integrity. Because these cells are non-dividing, the possibility of regeneration is limited after trauma. It is known that less surgical trauma comes lower endothelial damage.[5] Endothelial cell loss can occur during phacoemulsification from many causes such as hard and large nucleus, direct endothelial contact with nuclear fragments or intraocular lens (IOL) or air bubbles or surgical instruments, greater irrigation volume, type and implantation technique of IOL, ultrasound energy, short axial length, release of free

Table 2.1 Statistic comparison between pre and post-operative IOP of operated eyes

Pre-operative IOP	Post-operative IOP	P- value*
13.009 ± 3.38	Day 1 12.804 ± 4.25	0.6616
13.009 ± 3.38	Day 7 12.576 ± 3.65	0.2960

*chi square test

Table 3 Number of subjects in each VA range

VA outcomes	Pre-operative	Day 1	Day 7
PL	1	0	0
PJ	1	0	0
HM	2	0	0
FC	18	2	0
20/200	22	9	0
20/100	1	9	3
20/70	1	10	8
20/50	0	6	8
20/40	0	5	11
20/20	0	5	16

radical, small pupils, advanced age and toxic injury from intraoperative medications. Besides the above-mentioned parameters, the skill of surgeons are still crucial.[7-13]

Corneal endothelial cell studies by corneal thickness change analysis, in aspect of cell count, cell size (polymegathism), proportion of hexagonal cells (polymorphism) and alteration of endothelial cell function, are very useful to develop better surgical method.

In this study, the subjects were designed specifically on the never-operated eye cataract surgery and excluded any eye problems, other than cataract, to get rid of factors interfering IOP, CCT and VA measurement of both operated and the other eyes. To preclude surgical skill factor, all of the operations in this study were performed by only one defined surgeon, who had performed this type of operation for more than 10 years. We found that the central corneal thickness increased on day 1 post-operation but returned to approximate the baseline level when measured on day 7 post-operation. The study results might not be generalizable to those with higher or lower level of experience. The data were recorded at only pre-operation, day 1 and day 7 post-operation because of ambulatory purpose to early discharge the patients on day 1 and follow up on day 7.

We also assessed the IOP along with the CCT but did not find significant change of the IOP at the post-operative time. This finding is discordant to those of Brandt[14] who reported that CCT change may alter the IOP.

The visual acuity results on day 1 post-operation were better than at the pre-operative period and continued to improve to a satisfactory level on day 7 post-operation. These findings may be from the CCT change. From the study results, patients could then be informed of the visual acuity expectation at the different time point.

Conclusions

Increasing of CCT occured just immediately after surgical trauma, however, it resolved approximately to baseline level on day 7 without any effects on IOP.

Post-operative VA improvement related to CCT, most of the outcomes were good and excellent on day 7 as the same time as CCT returned to pre-operative baseline.

Surgical technique, instrument and surgical skill still are to get improved continuously to reduce surgical endothelial cell injury.

Acknowledgement

Dedicated to all of my patients.

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