

# Corneal Endothelial Cell loss from Modern Phacoemulsification

Jayawin Kajittanon, MD

Department of Ophthalmology

Queen Savang Vadhana Memorial Hospital, Sriracha, Chonburi Province

## Abstract

**Objective:** To evaluate corneal endothelial cell loss from modern phacoemulsification with topical anesthesia

**Material and Method :** One hundred and one eyes with age-related cataract were performed cataract surgery with topical anesthesia. Clear cornea phacoemulsification surgery with implantation of posterior chamber lens was performed by one surgeon.

The main parameter was corneal endothelial cell density (ECD) measured by using NIDEK SEM CS-4 non-contact specular microscope. Central endothelial cell count was measured before the operation and at postoperative day 7, day 30. Cell density was recorded as the number of cells per square millimeter . Comparison between preoperative ECD and postoperative ECD at day7, day 30 were done.

**Result:** Preoperative cataract surgery, the mean ECD was  $2487 \pm 235.68$  cell/mm<sup>2</sup>. The mean of ECD decreased 2.48%, 2.37% at day 7, day 30 respectively. The 95% confidence intervals of mean difference of endothelial cell loss at day 7 and day 30 were 42.86 - 80.02, 28.66 -89.36, respectively. Percent change between preoperative and postoperative at day 7 compare with percent change between preoperative and postoperative at day 30 was 0.11. The 95% confidence intervals of mean difference of percent change between pre-

operative and postoperative at day 7 compare with percent change between preoperative and postoperative at day 30 was -0.77-0.99, p value equal to 0.806.

There was no statistical difference between the changing of preoperative and postoperative endothelial cell loss at day 7 and day 30.

**Conclusion:** The corneal endothelial cell loss after modern cataract surgery with phacoemulsification was decrease minimally without statistical significant between the changing of preoperative and postoperative endothelial cell loss at day 7 and day 30.

**Keywords:** Cataract Surgery, Endothelial cell loss, Endothelial cell count, Endothelial cell density (ECD), Phacoemulsification, Intraocular lens implantation

## Introduction

Cataract is the leading cause of blindness worldwide<sup>1-4</sup>. With advances in microsurgical techniques in cataract surgery, small incision technique has been increasingly popular, because of its advantage; less surgical trauma, minimal postoperative induced astigmatism, faster rehabilitation and more quickly return to regular daily occupation. Consequently, this led to phacoemulsification becoming the preferred technique. The small incision (2.2 mm. - 2.75 mm.) for foldable

lens was frequently used, because of its advantage sutureless and non-traumatic wound. This study was designed to compare the endothelial cell loss in the conventional phacoemulsification method with foldable intraocular lens<sup>5-10</sup>

## Material and Method

One hundred and one eyes with age-related nuclear cataract (grade 2-4) were recruited from Ophthalmic clinic at Queen Savang Vadhana Memorial Hospital, Sriracha, Chonburi province, Thailand. All consenting patients were admitted for cataract surgery and willing to attend postoperative examination at day 7 and day 30 regularly. The exclusion criteria was patient with previous eye trauma or eye surgery, history of glaucoma, diabetic retinopathy, uveitis, dislocation, and subluxation len. Patients who had preoperative endothelial cell count  $\leq 1,500$  cell/mm<sup>2</sup> were excluded from this study.

Conventional phacoemulsification with a foldable intraocular lens was selected for all patients. Preoperative evaluation including best corrected visual acuity (BCVA), slitlamp biomicroscopy, applanation tonometry, retina evaluation, and non-contact specular microscopy were performed completely.

Surgery was done as an inpatient procedure with patient routinely admitted in the hospital for two days. All patients were operated by one surgeon. Local anesthesia with topical anesthetic drug (0.5%Tetracaine Hydrochloride, Alcon Laboratories,USA) was used. Preoperative antibiotic drug (Moxifloxacin hydrochloride 0.5%,Vigamox, Alcon Laboratories,USA) was used one day before the operation for four times.

Convention phacoemulsification, a temporal 2.7 mm. clear cornea incision was done with 2.7 mm keratome. Continuous curvilinear capsulorhexis was per-

formed in closed chamber by bend needle and anterior chamber formed with Duovisc (VisCoat) and ProVisc (1% sodium hyaluronate, and 3% sodium hyaluronate, 4% chondroitin sulfate, Alcon Laboratories, USA) viscoelastic for all case and followed by hydrodissection and hydrodelineation. Then nucleus was phacoemulsification with Alcon's series 20000 Advantec and Everest Legacy phacomachine, Alcon Laboratories, USA, using "phaco chop" technique, automated irrigation and aspiration was performed. The injected foldable lens (IOL) was implanted in capsular bag and the incision was unsutured. All patients were routinely use the combination of antibiotic and steroid (Tobramycin 0.3 % and Dexametasone 0.1 % , Tobradex<sup>®</sup>, Alcon Laboratories, USA and Moxifloxacin hydrochloride 0.5%,Vigamox,Alcon Laboratories, USA) as base four times per day for four weeks. The follow-up postoperative examination was carried out at day 1, day 7, and day 30 visits.

On the first post-operative day, Only visual acuity and slitlamp biomicroscopy were recorded. During subsequent examinations, all patients had a complete clinical evaluation including Snellen-chart best corrected visual acuity (BCVA), slitlamp biomicroscope, noncontact tonometry and keratometry.

The specular microscopy was done at day 7 and day 30 visit. Corneal endothelial cell count was undertaken in the central part of cornea using a NIDEK SEM ConfoScan CS-4, non-contact specular microscopy. (NIDEK CO.LTD, JAPAN) The measurements were performed in an automated masked manner.

The outcome of corneal endothelial cell loss was analyzed by 95% mean  $\pm$  standard deviation (SD) and confidence interval method.

## Results

One hundred and one patients were met the inclusion criteria and all of them completed all data of this study. Mean age of the patients was 64.58 years  $\pm$  10.95 (SD). The mean preoperative corneal endothelial count was 2487.55  $\pm$  235.68 (SD) cells/mm<sup>2</sup>. and the mean surgical time was 12.20 minutes.

Mean postoperative endothelial cell density at day 30 was 2428.54  $\pm$  274.86 cells/mm<sup>2</sup>. When the corneal endothelial cell loss was expressed as a percentage of preoperative endothelial cell count, the au-

thor found that the patient lost average 2.37% of cornea endothelial cell (Table 1) . The 95% confidence interval of the mean difference of endothelial cell lose at 7 day and 30 day were 42.86 - 80.02 and 28.66 -89.36. Percent change between preoperation - postoperation at day 7 and preoperation - postoperation at day 30 was -0.77-0.99 (mean 0.11, p-value 0.806). All the result shown that cornea endothelial cell loss on the follow up at day7 and day30 were decreased without statistical significant. (p-value=0.806) (Table 2)

**Table 1** Data of endothelial cell count

	Mean (cells/mm <sup>2</sup> )	SD
Preoperation	2,487.55	235.68
Postoperation at day 7	2,426.11	250.19
Postoperation at day 30	2,428.54	74.86
Percent change between preoperation and postoperation at day 7	2.48	3.73
Percent change between preoperation and postoperation at day 30	2.37	6.08

**Table 2** Comparisons of numbers cell change and percent cell change

	Mean	SD	95% Confidence Interval of the Difference		T test	p value
			Lower	Upper		
Number cells change between preoperation and postoperation at day 7	61.44	93.62	42.86	80.02	6.56	0.000
Number cells change between preoperation and postoperation at day 30	59.01	152.97	28.66	89.36	3.86	0.000
Number cells change between postoperation at day 7 and day 30	-2.43	110.11	-24.28	19.42	-0.22	0.826
Percent change between preoperation and postoperation at day 7 and Percent change between preoperation and postoperation at day 30	0.11	4.43	-0.77	0.99	0.25	0.806

## Discussion

Advances techniques for cataract surgery lead to decrease size of the incision wound especially when phacoemulsification and intracapsular foldable intraocular lens (IOLs) were developed, accompanied by decrease in incision size to 2.7 mm<sup>11-12</sup>. This decrease in incision wound size associates with decrease postoperative inflammation, less wound related complications, and less surgical time. All advantages bring to decrease cell loss in modern phacoemulsification<sup>13-15</sup>.

There were limitations in this study, only patients with early or moderate cataract (grade 2-3) according to the Lens Opacities Classification System II

were included in this study. Harder nucleus and complicated cases were excluded<sup>16</sup>.

In this study found that the decreasing mean of ECD were 2.48%, 2.37% at day 7, day 30 which was lower than the results of previous studies, the endothelial cell loss with phacoemulsification were 12.03% (Vaipayee and co-authors)<sup>17</sup>, 6.35% (Jongsareejit A) 18 and 7.18% (Kongsap P.).<sup>2</sup> The author demonstrated that the 95% confidence interval for the difference, the confidence interval located within the range of equivalence. From the data for cataract surgery, endothelial cell trauma decreased because of multiple factors, such as phacoemulsification machine, the mod-

ern phacoemulsification machine can stabilise anterior chamber from flow rate and phacoemulsification mode adjustment. Stable power decrease turbulence flow that can minimal trauma to cornea endothelial cell. Viscolastic material used in this study is designed to use the combination of viscolastic material (1 % sodium hyaluronate and chondroitin sulfate) with different physiochemical properties that the quality of endothelial property in chondroitin sulfate is higher than methylcellulose that can be used differently and sequentially to perform specific tasks during cataract procedure. It's suggested that the viscoelastic used in this study, chondroitin sulfate can protect endothelial cell more than methylcellulose<sup>19</sup>.

In conclusion, corneal endothelial cell loss in modern phacoemulsification was decreased compare to the previous study because of the quality of modern phacoemulsification machine and modern viscoelastic material.

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## การสูญเสียเซลล์กระจกตาชั้นใน จากการผ่าตัดสลายต้อกระจกด้วยคลื่นเสียงความถี่สูง

นายแพทย์ชัยวิญญู ขจิตานนท์

ฝ่ายจักษุ โสต ศอ นาสิก ลาริงซ์

โรงพยาบาลสมเด็จพระบรมราชเทวี ณ ศรีราชา จังหวัดชลบุรี

### บทคัดย่อ

**วัตถุประสงค์ :** เพื่อศึกษาเปรียบเทียบการสูญเสียเซลล์กระจกตาชั้นในจากการผ่าตัดต้อกระจกด้วยวิธีสลายต้อกระจกด้วยคลื่นเสียงความถี่สูง โดยหยอดยาชาเฉพาะที่

**วัสดุและวิธีการ :** ผู้นิพนธ์ได้ทำการศึกษาในผู้ป่วยที่ได้รับการผ่าตัดต้อกระจกจำนวน 101 ราย โดยผู้ป่วยทุกรายได้รับการผ่าตัดต้อกระจกด้วยวิธีสลายต้อกระจกด้วยคลื่นเสียงความถี่สูงโดยหยอดยาชาเฉพาะที่ ผู้ป่วยทุกรายได้รับการผ่าตัดโดยแพทย์ผู้ผ่าตัดคนเดียวกันและได้รับการใส่เลนส์แก้วตาเทียม ผู้ป่วยทุกรายได้รับการประเมินเซลล์กระจกตาชั้นใน, ภาวะแทรกซ้อนจากการผ่าตัด โดยนัดตรวจวันที่ 7 และวันที่ 30 หลังผ่าตัด

**ผลการศึกษา :** ค่าเฉลี่ยความหนาแน่นของเซลล์กระจกตาก่อนผ่าตัดเท่ากับ  $2487 \pm 235.68$  เซลล์/มิลลิเมตร<sup>2</sup> ค่าเฉลี่ยการสูญเสียเซลล์กระจกตาชั้นในหลังผ่าตัดเท่ากับ 2.48% , 2.37% ณ วันที่ 7 และวันที่ 30 ตามลำดับ ความแตกต่างของการสูญเสียเซลล์กระจกตาชั้นในเฉลี่ยมีความเชื่อมั่นที่ระดับ 95% ณ วันที่ 7 และวันที่ 30 อยู่ระหว่าง 42.86 - 80.02 และ 28.66 - 89.36 ตามลำดับ การเปลี่ยนแปลงเป็นเปอร์เซ็นต์ระหว่างการสูญเสียเซลล์กระจกตาชั้นในก่อนผ่าตัดและหลังผ่าตัด ณ วันที่ 7 กับการเปลี่ยนแปลงเป็นเปอร์เซ็นต์ระหว่างการสูญเสียเซลล์กระจกตาชั้นในก่อนผ่าตัดและหลังผ่าตัด ณ วันที่ 30 เท่ากับ 0.11% ค่าความเชื่อมั่นที่ระดับ 95% ของค่าเฉลี่ยความแตกต่างของการเปลี่ยนแปลงเป็นเปอร์เซ็นต์ระหว่างก่อนผ่าตัดและหลังผ่าตัดที่วันที่ 7 เปรียบเทียบกับการเปลี่ยนแปลงเป็นเปอร์เซ็นต์ระหว่างก่อนผ่าตัดและหลังผ่าตัดที่วันที่ 30 เท่ากับ - 0.77 ถึง 0.99 ( $P = 0.806$ ) ในการศึกษาครั้งนี้ไม่พบความแตกต่างทางสถิติระหว่างการเปลี่ยนแปลงของเซลล์ชั้นในของกระจกตาก่อนการผ่าตัดและหลังการผ่าตัด ณ วันที่ 7 และวันที่ 30

**สรุป :** การสูญเสียเซลล์กระจกตาชั้นในหลังการผ่าตัดสลายต้อกระจกด้วยคลื่นเสียงความถี่สูง มีการสูญเสียเซลล์กระจกตาชั้นในเล็กน้อย โดยไม่มีนัยสำคัญทางสถิติระหว่างการเปลี่ยนแปลงเมื่อเทียบจากก่อนผ่าตัดกับหลังผ่าตัด ณ วันที่ 7 และวันที่ 30