

## EFFECT OF CATARACT SURGERY (PHACO AND MANUAL SMALL INCISION CATARACT SURGERY) ON THE CORNEAL ENDOTHELIUM- A COMPARATIVE STUDY

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### ABSTRACT

#### BACKGROUND

The aim of the study is to compare the effect of phacoemulsification cataract surgery and manual small incision cataract surgery on the corneal endothelial cell count.

#### MATERIALS AND METHODS

A prospective study was carried out on 100 patients who underwent cataract surgery by manual small incision cataract surgery (SICS) and phacoemulsification at the Regional Institute of Ophthalmology and Government Ophthalmic Hospital, Chennai, during the period from August 2005 to August 2006. Surgeries done by a single surgeon was taken for the study.

#### RESULTS

A total of 100 patients were included in the study out of which 50 underwent phacoemulsification and 50 underwent manual SICS. In manual SICS, endothelial count loss of between 100-500 cells was higher with an incidence of 44% (22 eyes) and a count loss of >1500 cells was also found with an incidence of 8% (4 eyes). Endothelial cell loss of <100 was found to be 18% (9 eyes). In phacoemulsification, endothelial cell count loss of <100 cells only was found to be highest with an incidence of 46% (23 eyes) and a loss of >1500 was not made out in this study.

#### CONCLUSION

Endothelial cell count loss by this study was found to be less with phacoemulsification surgery than with manual SICS. Phacoemulsification surgery was found to be superior to manual SICS by ensuring minimal injury to the endothelial cells and thus provide a good BCVA immediately after the surgery when compared to manual SICS, thus providing a quicker visual recovery.

#### KEYWORDS

Corneal Endothelium, Manual Small Incision Cataract Surgery, Phacoemulsification.

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#### BACKGROUND

Over the years from Susruta's couching to Charles. D. Kelman's phacoemulsification, cataract surgery has witnessed a phenomenal progress. The successful cataract surgery is determined by the best and the earliest possible visual rehabilitation. Introduction of phacoemulsification by Kelman and no-stitch surgery by McFarland are the major advances in reducing the destruction of the endothelium and in achieving quick visual rehabilitation. Charles D. Kelman the pioneer in phacoemulsification surgery has written in one of his books "those of us who perform the

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technique become enamoured of the procedure, elated by the white, quiet postoperative eyes, proud of the work as an artist is proud of his and empathetic with the patient who back at work the next day proclaim that he had a cataract removed the day before and has no physical limitation." It seems we are now very close to ideal cataract surgery-our ultimate goal. Successful cataract surgery depends on the good endothelial count preoperatively and postoperatively. This observation of corneal endothelium by specular reflection date back to the early part of 20th century by Vogt demonstrated the first direct visualisation of corneal endothelial cells using principle of specular microscopy in 1918 using S/L biomicroscope.<sup>1</sup> We hope that this corneal endothelial study helps us to choose an ideal technique for extraction of cataractous lens in order to get a good visual rehabilitation in immediate postoperative period as mentioned by our pioneer-our ultimate goal. Cornea provides 75% of the refractive power of the eye and corneal transparency is required for clear vision. The corneal endothelium is a single cell layer lining the inner



surface of cornea and plays an important role in corneal deturgescence. The normal cornea at birth has a high endothelial cell density.<sup>2</sup>The range of cell counts for individuals is 1500-3500 cells/mm<sup>2</sup>. The purpose of study is to ascertain whether there is any alteration in endothelial counts by various techniques of cataract surgery.

## MATERIALS AND METHODS

A prospective study was carried out on 100 patients who underwent cataract surgery by manual SICS and phacoemulsification at the Regional Institute of Ophthalmology and Government Ophthalmic Hospital, Chennai, during the period from August 2005 to August 2006. Surgeries done by a single surgeon is taken for the study. Inclusion criteria are senile cortical cataract and nuclear cataract, age between 30-70 years. Exclusion criteria are pre-existing corneal diseases, complicated cataract, cataract associated with glaucoma, detectable posterior segment lesions, systemic illness and irregular follow up. Preoperative evaluation of patients include detailed history and routine investigations for IOL surgery like recording of best corrected visual acuity (BCVA) with Snellen's or E-chart recording tension with Schiottz tonometer assessing the patency of duct, K-reading measurement using Bausch and Lomb keratometer, A scan and IOL power calculation using SRK II formula, slit lamp examination for grading of nucleus and anterior segment evaluation, cell density of endothelium evaluated using Topcon noncontact specular microscope, necessary parameters for systemic profile (diabetes mellitus and hypertension) and evaluation of status of other eye also was done.

### Surgical Details

Preoperatively, adequate pupillary dilatation was achieved one hour prior to surgery with application of tropicamide and 10% phenylephrine for three times. Peribulbar anaesthesia was used in all cases. Ocular hypotony was achieved with digital compression. The external incision was made about 2 mm from limbus with No.11 blade and was shaped either linear or frown. A 5.5 mm (phaco) or 6 mm (manual SICS) long sclera, corneal tunnel incision and self-sealing corneal valve was fashioned after making a fornix based conjunctival flap. Tunnel was created with a crescent blade upto 1.5 mm into clear cornea. Entry into AC was made with 3.2 mm keratome and later extended.<sup>3</sup>

In manual small incision cataract surgery, a can opener capsulotomy or continuous curvilinear capsulorhexis was performed with a 26G needle cystitome depending on the type of cataract and pupillary dilatation. The nucleus was prolapsed into AC using hydrodissection and hydraulic expression and then was removed with irrigating vectis. All manipulation was carried out under cover of viscoelastic agents. Cortex was aspirated with simcoe cannula. Single piece PMMA 6 mm optic IOL was inserted through the tunnel into capsular bag and properly centered. Anterior chamber was formed and the wound was allowed to self-seal. Surgery was concluded with a subconjunctival

injection of 0.5mL dexamethasone, 4 mg after repositioning conjunctiva over the wound.<sup>4</sup>

In phacoemulsification, surgery after entry into AC with 3.2 mm keratome phaco probe was introduced into AC and was guided into lens substance. For soft cataracts, phaco aspiration was done and in other type of cataracts nucleus was emulsified using divide and conquer technique.<sup>5</sup>

Thorough cortical clean-up was done followed by in the bag placement of phaco PMMA lens of 5.25 mm optic. AC was formed and wound allowed to self-seal. Surgery was completed with a subconjunctival injection of 0.5mL dexamethasone 4 mg.<sup>6</sup>

Postoperative management and follow up- Patients received topical steroids, antibiotic drops and 1% cyclopentolate eye drops. Patients were subjected to specular microscopy on the fourth postoperative day. The V/A was recorded. The corneal endothelial count was recorded. The findings were tabulated on a specially prepared proforma and various parameters were studied.

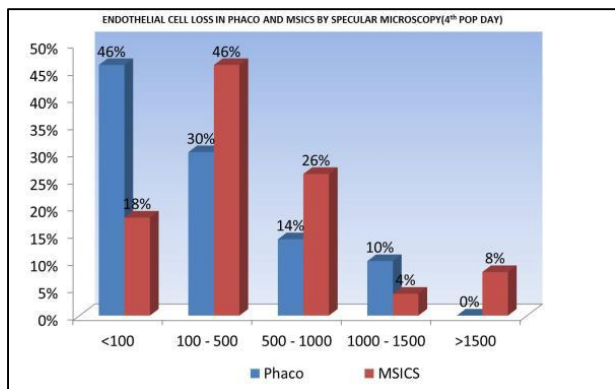
## RESULTS

In Manual Small Incision Cataract Surgery, 20 eyes (40%) had grade III cataract, which was the commonest type. Among the preoperative complications, rupture of posterior capsule and premature entry was the commonest with an incidence of 4% and 6%, respectively. The incidence of complications were higher as the grading of nuclear sclerosis<sup>7</sup> increased. Endothelial cell count loss of between 100-500 cells was found to be higher with an incidence of 44% (22 eyes) and a count loss of >1500 cells was also found with an incidence of 8% (4 eyes). Endothelial cell loss of count<100 was found to be 18% (9 eyes).30 out of 50 eyes (61%) had best corrected visual acuity of 6/9-6/18.

In phacoemulsification surgery, commonest type of cataract operated was grade 2 nuclear sclerosis with an incidence of 52% (26 eyes).Among the frequent complications, rupture of posterior capsule was found to be the commonest with an incidence of 10% (5 eyes) due to improper hydrodissection. Even with the increased grading of nuclear sclerosis, an endothelial cell count loss of<100 cells only was found to be highest with an incidence of 46% (23 eyes) and a loss of >1500 was not made out in this study. 36 out of 50 eyes (72%) had a vision of 6/6-6/9, (the difference in cell density preoperatively and postoperatively by specular microscopy between phaco and manual SICS was found to be statistically significant 'p' value <0.018 (5% level).

Phaco	Power %	Vacuum (mm/H)	Flow rate (cc/mt)
Trenching	70-80	50	10-20
Quadrant emulsification	50-60	200	25-30

**Table 1. Phaco Parameters**



**Graph 1. Endothelial Cell Loss**

Grade	Colour of Nucleus	Number of Eyes	Percentage
Grade I	White or green and yellow	22	22
Grade II	Yellow	44	44
Grade III	Amber	22	22
Grade IV	Brown	0	0
MC	White	12	12

**Table 2. Colour of Nucleus**

Grade of Nucleus	Number of Eyes	Percentage
I	2	4
II	18	36
III	20	40
Mature cataract	10	20

**Table 3. Age Group Vs. % of Cataract**

Peroperative Complications	Number of Eyes	Percentage
P.C.R.	2	4
Premature entry	3	6
Difficulty in delivering nucleus	2	4

**Table 4. Peroperative Complications**

Complications	Number of Eyes	Percentage
Vitreous disturbance	5	10
Increased irritation	3	6
Increased phaco time	3	6

**Table 5. Complications of Percentage**

Endothelial Cell Count	Number of Eyes	Percentage
<100	23	46
100-500	15	30
500-1000	7	14
>1000	5	10

**Table 6. Endothelial Cell Count**

BCVA	Number of Eyes	Percentage
6/6	20	40
6/9	16	32
6/12	9	18
6/18	5	10

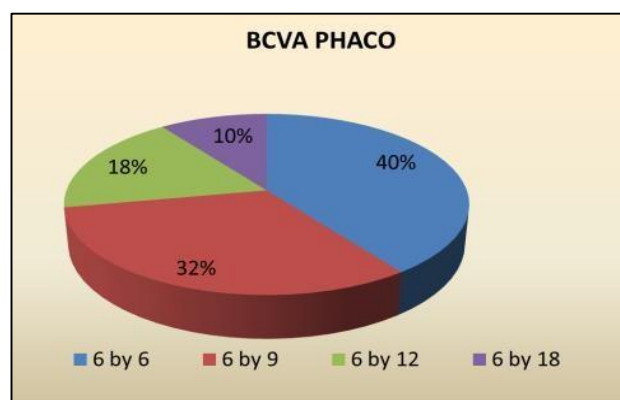
**Table 7. BCVA on Fourth Postoperative Day**

Endothelial Cell Count	Number of Eyes	Percentage
<100	9	18
100-500	23	46
500-1000	13	26
1000-1500	2	4
1500>	4	8

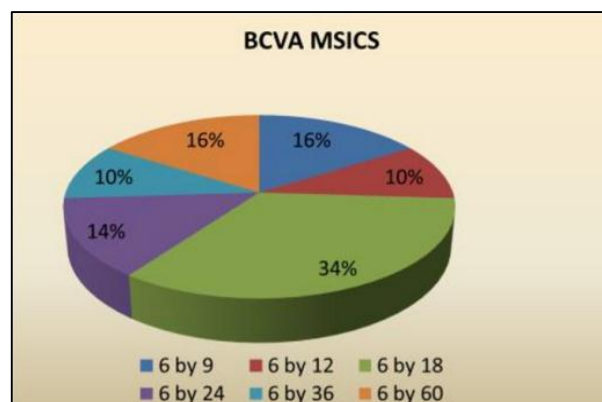
**Table 8. Endothelial Cell Count by Percentage**

BCVA	Number of Eyes	Percentage
6/9	8	16
6/12	5	10
6/18	17	35
6/24	7	14
6/36	5	10
6/60	8	16

**Table 9. BCVA on Fourth POP Day**



**Graph 2. BCVA Phaco**



**Graph 3. BCVA Phaco**

Grade of Nucleus	Number of Eyes	Percentage
Grade I	20	40
Grade II	26	52
Grade III	2	4
MC	2	4

**Table 10. Grade of Nucleus by Percentage**



**Figure 1. Preoperative Cell Count**



**Figure 2. Postoperative Cell Count**

## DISCUSSION

100 patients were included in this study. 56 patients were females and 44 of them were males. Age of patients ranged from 30-70 years. The mean age of patients was 52.18 years. Clinical hardness of lens nucleus was graded based on S/L evaluation of color of nucleus.

50 patients who underwent manual SICS had superior scleral incision, which was self-sealing and suture less and had superotemporal 50 patients who underwent phaco surgery few had superotemporal<sup>8</sup> and few patients had superonasal scleral incision.

### Phaco Surgery

50 patients underwent this surgery. 20 of them were males and 30 females. Age of the patients ranged for 30 to 70 years. Mean age was 52.18 years. Nuclear grading between grade I-III and 2 of them had mature cataract.

Grade II cataract was the commonest and was seen in 26 eyes (52%). Incision was linear and CCC was done in all cases.

The commonest intraoperative complication was PC rupture with an incidence of 10%. Endothelial cell count done using noncontact specular microscopy and taking an

average count of 30 cells in all eyes. The endothelial count is shown in Table 5.

The endothelial cell loss of 500-1000 and above were found to be due to the complications like PCR, increased phaco time and increased fluids in the AC (prolonged irrigation).<sup>5</sup>

The endothelial loss of <100 cells were found in majority of eyes 46% who underwent phaco surgery. 36 out of 50 eyes (72%) had 6/6-6/9 vision in patients who underwent phaco surgery in the immediate postop period (4<sup>th</sup>POD) and the 'p' value for BCVA was not statistically significant.

MSICS (manual small incision cataract surgery) 50 patients underwent this surgery. 22 of them were males and 28 of them females. Age of patients ranged from 35-70 years. Mean age was 55.58 years. Nuclear grading in this group was between I-III and 10 persons had MC.

Grade III cataract was commonest and was seen in 20 eyes (40%), all eyes had a linear incision and a continuous curvilinear capsulorhexis.<sup>9</sup>

Endothelial cell count was done with the noncontact specular microscopy taking an average count of 30 cells in all eyes Table 7.

Endothelial cell loss of 100-500 was found in 23 eyes (46%) who underwent manual SICS tunnel surgery.<sup>10</sup> A cell loss of >1500 was found in 4 eyes (8%) who underwent non-phaco cataract surgery and this incidence was very minimal with phaco surgery and the 'p' value was statistically significant at 1% level (p value <0.001). As shown in Table 8, 30 out of 50 eyes had BCVA of 6/9-6/18 in patients who underwent manual SICS. 40% of patients who had a decreased vision of 6/24-6/60 recovered a vision of 6/6 and 6/9 after a few weeks postoperatively. 'p' value for BCVA was statistically significant at 1% level.

## Suggestions

Comparison of similar grading of cataract by phaco and manual SICS and consistency in phaco time to be maintained for better comparison.

## CONCLUSION

Endothelial cell count loss by this study was found to be less with phaco surgery than with manual SICS. The endothelial cells loss attributed to the phaco surgery by this study was found to be mostly due to intraoperative complication like post capsular rupture with vitreous disturbance, increased irrigation in the anterior chamber, increased phaco time in few cases and sometimes due to difficulty in IOL manipulation.<sup>11</sup> The optical property of the cornea can be maintained by protecting endothelium by following a proper technique in all the steps right from the incision to implementation of IOL. Phaco surgery was found to be superior to manual SICS by ensuring minimal injury to the endothelial cells and thus provide a good BCVA when compared to manual SICS immediately after the surgery, thus providing a quicker visual recovery.

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