



## A CLINICAL STUDY ON CORNEAL ENDOTHELIAL DENSITY BEFORE AND AFTER MANUAL SMALL INCISION CATARACT SURGERY(M-SICS).

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### ABSTRACT

**AIM-**to study the corneal endothelial density before and after Manual small incision cataract surgery(M-SICS).

**MATERIALS AND METHODS-**a total of 100 eyes of 100 patients undergoing M-SICS with PCIOL were included in the study. A detailed history, thorough ocular examination including laboratory tests were done. Endothelial cell density was measured with specular microscope pre-operatively and post-operatively at 1 week, 1 month and 3<sup>rd</sup> month.

**RESULTS-** The mean endothelial cell density(ECD) before undergoing operation was  $2597.11 \pm 224$ (SD) while post-operatively at 1<sup>st</sup> week, 1<sup>st</sup> month and at 3<sup>rd</sup> month were  $2377.39 \pm 223$ (SD),  $2349.36 \pm 223$ (SD) and  $2328 \pm 224$ (SD) cells/sq mm respectively. There is reduction of 8.5%, 9.5% and 10.4% endothelial cells at 1<sup>st</sup> week, 1 month and 3<sup>rd</sup> month respectively.

**CONCLUSION -** Endothelial cell loss after Manual SICS is comparable to other extracapsular cataract surgery. Hence Manual SICS can be considered as an alternative to Phacoemulsification in developing countries

### KEYWORDS :

#### INTRODUCTION

Cataract is the chief cause of avoidable blindness in India and throughout the world.<sup>1</sup> It constitutes around 47.8% of global blindness with India accounting for 62.6%.<sup>2,3</sup> In India cataract has been reported to be responsible for 50-80% of the bilaterally blind in the country. Despite the 10 to 12 million cataract operations performed globally, cataract blindness is still thought to be increasing by 1 to 2 million/year.<sup>11</sup> In order to effectively address this increasing backlog, significant efforts are being undertaken to increase the output of cataract surgical services in many developing countries<sup>12</sup> and to make cataract surgery affordable to all people irrespective of their economic status.

The main objective in modern cataract surgery is to achieve a better-aided visual acuity with rapid post-surgical recovery and minimal surgery related complications. In manual small incision cataract surgery (MSICS) it is between 5.5 and 6.5 mm, Despite excellent facilities and skilled surgeons, the poorer section in the developing world are even deprived of the visual benefits of the IOL because of their inability to afford them.<sup>13</sup> With this background phacoemulsification with all its benefits may not be an affordable technique due to the cost involved in the developing countries. Alternatively manual SICS with its relatively smaller incision has similar advantages to phacoemulsification and is affordable.

#### MATERIAL AND METHODS

The present study was conducted in the Regional Institute of Ophthalmology, Gauhati Medical College from June, 2017 to May, 2018 for a period of one year.

#### Case selection and study protocol

100 cases were selected from the outdoor patients of RIO, Guwahati. Informed and written consent was obtained from the patients after explaining the purpose of the study.

#### Inclusion criteria:

1) Patients with senile cataract

#### Exclusion criteria :

- 1) Developmental or congenital cataract
- 2) Traumatic cataract
- 3) Complicated cataract
- 4) Glaucoma
- 5) Acquired or hereditary corneal pathology
- 6) Past history of ocular trauma or systemic diseases like diabetes mellitus.

#### Methodology

A detailed history and a thorough ocular and systemic examination was

done. One day prior to surgery (MSICS), Specular microscopy was done in the cataractous eye for determining corneal endothelial count and other morphological parameters like average cell size, minimum and maximum cell size, coefficient of variation of cell size. All cases were evaluated after 1 week, 1 month and 3 months for recording the same endothelial parameters as described earlier. For specular microscopy, The Topcon SP-3000P Specular microscope was used.

#### RESULTS AND OBSERVATIONS

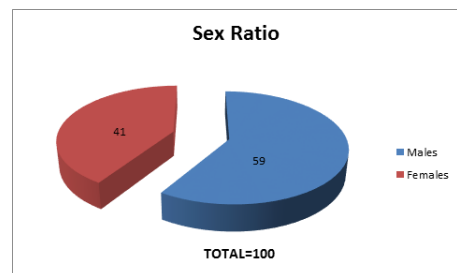
##### Sex distribution

The total number of cases selected for our study was 100; out of which 41(41%) were females and 59(59%) were males.

**Table 1. Sex distribution**

	Males	Females
Number	59(59%)	41(41%)

**Chart 1. Sex Distribution**



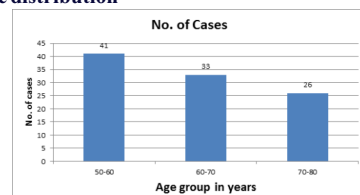
##### Age distribution

The mean age was  $63.18 \pm 8.39$ (SD) years ranging from 51 years to 79 years

**Table 2. Age distribution**

Age group (in years)	No. of Cases
50-60	41(41%)
60-70	33(33%)
70-80	26(26%)

**Chart 2. Age distribution**



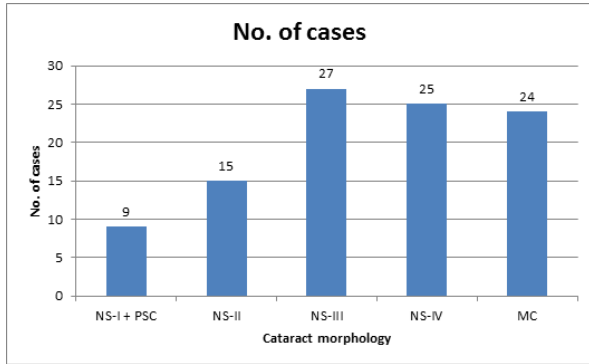
**Morphology of the cataract**

The distribution of morphology of the cataract is shown in the following table and chart

**Table 3. Distribution of cataract morphology:**

Cataract morphology	No. of cases
NS-I + PSC	9(9%)
NS-II	15(15%)
NS-III	27(27%)
NS-IV	25(25%)
MC	24(24%)

**Chart 3. Distribution of cataract morphology**



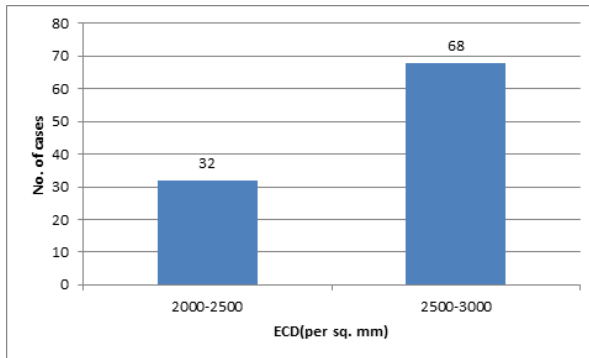
**Endothelial cell count(ECC)**

The mean endothelial cell count(ECC) before undergoing operation was  $2597.11 \pm 224$ (SD). After 1 week, the mean ECC was  $2377.39 \pm 223$ ( $p < 0.05$ ). After 1 month, the mean ECC was  $2349.36 \pm 223$ (SD) ( $p < 0.05$ ). After 3 months, the mean ECC was  $2328 \pm 224$ (SD) ( $p < 0.05$ ). The mean reduction of endothelial cell count at every follow-up was statistically significant. ( $p < 0.05$ )

**Table 4. ECC distribution before operation**

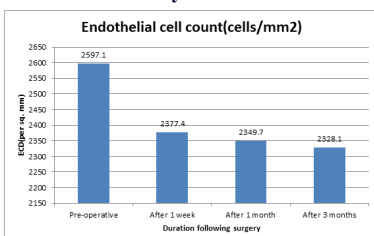
ECC(per mm <sup>2</sup> )	No. of cases
2000-2500	32(32%)
2500-3000	68(68%)

**Chart 4. ECC distribution**



	Pre-operative	After 1 week	After 1 month	After 3 months
Endothelial cell count (cells/mm <sup>2</sup> )	2597.1	2377.4	2349.7	2328.1
Endothelial cell loss (cells/mm <sup>2</sup> )		220	247	269
% loss (p-value)		8.5% (P<0.05)	9.5% (P<0.05)	10.4% (P<0.05)

**Chart 5. Endothelial cell density and cell loss over time**



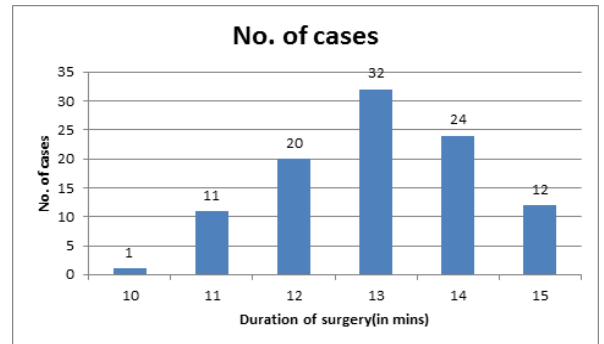
**Duration of surgery:**

The average duration of surgery for each case was  $13 \pm 1.2$ (SD) mins, ranging from 10 to 15 mins. The duration of each surgery was recorded from the time of sideport entry upto the completion of the viscoelastic washout from the anterior chamber following IOL implantation.

**Table 6. Duration of Surgery**

Duration(in minutes)	No. of cases
10	1(1%)
11	11(11%)
12	20(20%)
13	32(32%)
14	24(24%)
15	12(12%)

**Chart 6. Duration of Surgery**



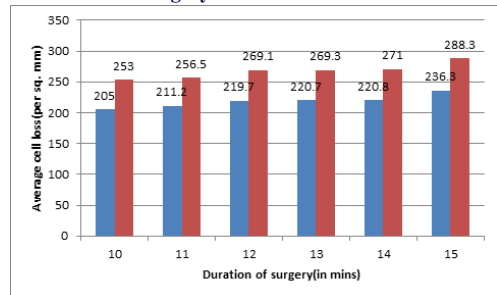
**Duration of surgery vs endothelial cell loss**

The average amount of endothelial cell loss depending upon the duration of surgery is shown in the following table and chart. For those cases with duration of surgery ranging from 10 to 14 mins, the difference in the amount of cell loss were statistically not significant amongst them ( $p > 0.05$ ). Those cases whose surgery took 15 mins had a cell loss which was significantly higher than those cases with duration of surgery ranging from 10-13 minutes ( $P < 0.05$ ); but no significant difference was found between those cases having duration of surgery 14 and 15 minutes ( $P = > 0.05$ ). At the end of 3 months, the difference in the amount of cell loss between those cases whose surgery lasted 10 minutes and 15 minutes was significant. ( $P < 0.05$ ), otherwise no significant difference in cell loss were observed in other groups. The correlation coefficient between the duration of surgery and the amount of endothelial cell loss on the first week was found to be +0.04 at 1 week and increased to +0.89 at the end of 3<sup>rd</sup> month.

**Table 7. Duration of surgery vs endothelial cell loss (p values)**

Duration of surgery (minutes)	No. of cases	Average cell loss±SD (per sq mm) on 1st week	Average cell loss±SD (per sq mm) on 3rd month
10	1(1%)	205	253
11	11(11%)	211.2±25.1	256.5±23
12	20(20%)	219.7±14.9	269.15±18.9
13	32(32%)	220.7±28.21	269.34±34.18
14	24(24%)	220.8±12	271±16.4
15	12(12%)	236.3±17.6	288.3±19.9

**Chart 7. Duration of surgery vs endothelial cell loss**



**Average cell size**

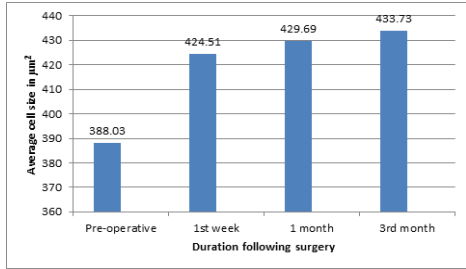
Preoperatively, the average cell size of the endothelial cell size was  $388.03 \pm 35.21$ (SD). On the first postoperative week, the average cell size was  $424.51 \pm 42.14$ (SD) which is statistically significant. After 1

month ,the average cell size was 429.69±43.14(SD).After 3 months, the average cell size was 433.73±44.1.The change in average cell size in all follow-up was significant(p-value<0.05)

**Table 10. Change in the average cell size over time.**

	Pre-operative	1 <sup>st</sup> week	1 month	3rd month
Average cell size(μm <sup>2</sup> )	388.03	424.51	429.69	433.73
p-value		P<0.05	P<0.05	P<0.05

**Chart 10. Change in the average cell size over time.**



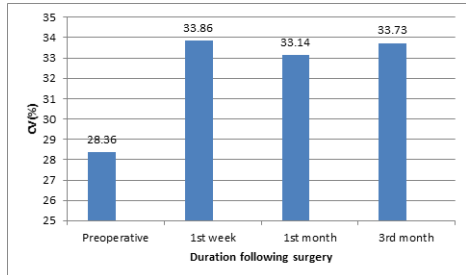
**Coefficient of variation(CV) of cell size**

The mean Coefficient of variation(CV) of cell size before operation was 28.36±4(SD) %.On the first postoperative week,the mean CV increased to 33.86±4.8(SD) %.The mean CV at 1<sup>st</sup> month and 3<sup>rd</sup> month were 33.14±31(SD)% and 33.73±4.5(SD) %. The change in the mean CV at every follow-up was statistically significant(p<0.05)

**Table 11. Coefficient of variation(CV) of cell size over time**

	Preoperative	1 <sup>st</sup> week	1 <sup>st</sup> month	3 <sup>rd</sup> month
CV(%)	28.36	33.86	33.14	33.73
Change in CV		5.5	4.78	5.37
p- value		P=0.026	P=0.001	P=0.030

**Chart 11. Change in Coefficient of variation(CV) of cell size over time**



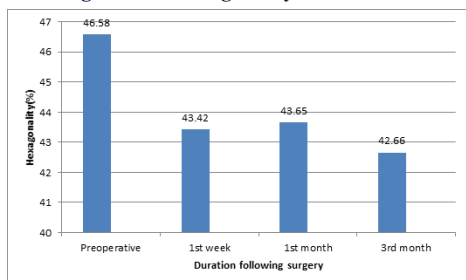
**Hexagonality of cells**

The mean percentage of hexagonal cells before the operation was 46.58±6.2(SD) %.On the first week,the mean hexagonality of cells reduced to 43.42±6(SD) %.The the mean hexagonality of cells at 1st and 3rd month were 43.65±6.8(SD) % and 42.66±6.7(SD) % respectively.

**Table 12.Change in mean hexagonality of cells over time**

	Preoperative	1 <sup>st</sup> week	1 <sup>st</sup> month	3 <sup>rd</sup> month
Hexagonality(%)	46.58	43.42	43.65	42.66
Change in hexagonality		-3.16	-2.93	-3.92
p- value		P=0.001	P<0.001	P<0.001

**Chart 12. Change in mean hexagonality of cells over time**



**DISCUSSION**

The mean endothelial cell count(ECC) before undergoing operation was 2597.11 ± 224(SD). After 1 week ,the mean ECC was 2377.39 ±

223 (8.5% Reduction) which was statistically significant (p<0.05) . After 1 month,the mean ECC was 2349.36±223(SD) (p<0.05)(9.5% reduction). After 3 months,the mean ECC was 2328± 224(SD)(10.4% reduction) (p<0.05). The mean reduction of endothelial cell count at every follow-up was statistically significant(p<0.05).

Somil N. Jagani et al<sup>163</sup> conducted a study to compare the endothelial cell loss between phacoemulsification(Group A) and manual small-incision cataract surgery (SICS)(Group B). Mean endothelial cell loss (cells/mm<sup>2</sup>) in Group A was 307.80 (12.33%), 397.79 (15.93%), and 421.69 (16.89%) on 1st week, 6th week, and 3 month postoperative period,respectively. In Group B, it was 270.86 (10.63%), 385.22 (15.12%), and 413.68 (16.24%) on 1 week,6 week, and 3 month postoperative period, respectively. No statistical significant difference was present(P > 0.05)between the two groups. There was statistically significant difference in endothelial cell loss at 1 week (P < 0.05)but it was not statistically significant on 6 week and 3 month postoperatively (P > 0.05).

The average duration of surgery for each case was 13 ± 1.2(SD) mins,ranging from 10 to 15 mins. For those cases with duration of surgery ranging from 10 to 14 mins, the difference in the amount of cell loss were statistically not significant amongst them(p>0.05). Those cases whose surgery took 15 mins had a cell loss which was significantly higher than those cases with duration of surgery ranging from 10-13 minutes(P<0.05) ; but no significant difference was found between those cases having duration of surgery 14 and 15 minutes(P=>0.05). At the end of 3 months,the difference in the amount of cell loss between those cases whose surgery lasted 10 minutes and 15 minutes was significant.(P<0.05),otherwise no significant difference in cell loss were observed in other groups.The correlation coefficient between the duration of surgery and the amount of endothelial cell loss on the first week was found to be +0.04 at 1 week and increased to +0.89 at the end of 3<sup>rd</sup> month.

**Tunnel length vs endothelial cell loss**

The average length of the tunnel as measured by the caliper was 6.7± 0.6(SD) mm, ranging from 5.5 to 7.5mm.

It is observed that,the average amount of endothelial cell loss appears to be more with the increase in the length of the sclera-corneal tunnel. The differences in the amount of cell loss corresponding to the differences in the tunnel length are not significant statistically on 1<sup>st</sup> and 3<sup>rd</sup> month.(p>0.05)

The correlation coefficient between the tunnel length and the average amount of cell loss was =+0.163 at 1 week which increased to +0.167 at 3 months.This shows there is a weak positive correlation between the tunnel length and the average amount of endothelial cell loss.

**Average cell size**

Preoperatively,the average cell size of the endothelial cell size was 388.03±35.21(SD)μm<sup>2</sup> .On the first postoperative week,the average cell size was 424.51±42.14(SD) μm<sup>2</sup> which is statistically significant.After 1 month,the average cell size was 429.69±43.14(SD) μm<sup>2</sup>.After 3 months, the average cell size was 433.73±44.1 μm<sup>2</sup>. The mean increase in cell size was 46 μm<sup>2</sup>.The change in average cell size in all follow-up was significant(p-value<0.05).

Yengkhom Shailendra Singh in his study 'A study of corneal endothelial cell count before and after manual small incision cataract surgery' found the average cell size to be 421.5±42.6(SD) μm<sup>2</sup> which is statistically significant.After 1 month ,the average cell size was 420.95±45(SD) μm<sup>2</sup>(p<0.05).After 3 months, the average cell size was 420.82±41.6(SD) μm<sup>2</sup>(p<0.05).<sup>184</sup>

The results of this study matched with the studies done by the above mentioned authors.

**Coefficient of variation(CV)**

The mean Coefficient of variation(CV) of cell size before operation was 28.36±4(SD) %.On the first postoperative week,the mean CV increased to 33.86±4.8(SD) %.The mean CV at 1<sup>st</sup> month and 3<sup>rd</sup> month were 33.14±31(SD)% and 33.73±4.5(SD) %. The change in the mean CV at every follow-up was statistically significant(p<0.05).

%CV (cell size variability) is an indicator of the uniformity of the size of endothelial cells. High values indicate high levels of pleomorphism.

It indicates the activity of the repair and healing mechanism of the endothelium after an insult.

Hugod *et al.* also found a decrease in the %CV (33.2 at 3 months as compared to 33.7 preoperatively), but this change was not found to be statistically significant.<sup>186</sup>

Pramod K. Sahu *et al.*<sup>187</sup> conducted a comparative evaluation of corneal endothelium in patients with diabetes and controls undergoing phacoemulsification. The CV(%) showed an increase from 34.55% to 39.08% in non-diabetics and 33.01% to 36.20% in diabetics. Both the groups showed an increase in the percentage coefficient of variation (%CV) at postoperative 3-month follow-up and these values were significantly different ( $P < 0.001$ ) from preoperative value. The increase was higher in the control group and was statistically significant ( $P = 0.002$ ).

Our study shows similar increase (%) in cv as compared to studies conducted by Soichi Morikubo *et al.* and Pramod K. Sahu *et al.* Hugod *et al.* study showed a decline in cv which was conducted on diabetic patients. The statistical significance was similar to the study conducted by Pramod K. Sahu *et al.*

### Hexagonality of cells

The mean percentage of hexagonal cells before the operation was  $46.58 \pm 6.2$  (SD) %. On the first week, the mean hexagonality of cells reduced to  $43.42 \pm 6$  (SD) %. The mean hexagonality of cells at 1<sup>st</sup> and 3<sup>rd</sup> month were  $43.65 \pm 6.8$  (SD) % and  $42.66 \pm 6.7$  (SD) % respectively. The change in percentage hexagonality was significant ( $P < 0.001$ ).

Soichi Morikubo *et al.*<sup>177</sup> conducted a study to evaluate functional impairment in the corneal endothelium of eyes between patients with diabetes mellitus and non-diabetics, after small-incision cataract surgery. The percentages of hexagonal cells 1 day, 1 week, and 1 month after operation were 56.7%, 57.7%, and 57.2%, respectively, in the non-diabetic group and 53.3%, 55.6%, and 55.7%, respectively, in the diabetic group, without significant differences between the 2 groups.

Our study had also gradual decline of hexagonality over a 3 month post-operative period as compared to studies done by Soichi Morikubo *et al.* and Pramod K Sahu *et al.* with slight differences in the hexagonality(%) which could be due to the difference in the endothelial cell loss, type of procedure performed. The change in percentage hexagonality was significant as seen in our study.

### CONCLUSION

The effect of cataract surgery with posterior chamber intraocular lens implantation on the corneal endothelial cells has been well documented in the literature. Numerous studies conducted in the past have shown a variable amount of endothelial cell loss depending upon the various techniques of surgery employed.

Our study aimed at finding the corneal endothelial cell count before and after Manual SICS with PCIOL and also to find out any change in endothelial cell size and shape postoperatively.

From our study, it can be concluded that

- 1) Endothelial cell count has decreased postoperatively which is proportional to the duration of surgery and the length of the sclera-corneal tunnel.
- 2) Cell size area and coefficient of variation (polymegathism) has increased with an decrease in hexagonality of cells (pleomorphism).

The above change in the morphological parameters are justifiable in view of the corneal endothelial response to trauma.

As corneal endothelium is among the determinant of good outcome of cataract surgery by playing an important role in maintaining the corneal transparency hence during surgery, following measures should be taken to protect the integrity of corneal endothelium.

- 1) Less duration of surgery
- 2) Proper length of sclera-corneal tunnel
- 3) Lesser intraoperative manipulations.
- 4) Use of viscoelastics.