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Specular Microscopic Changes in Corneal Endothelium after Cataract Surgery in different Age Group

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ABSTRACT

Introduction: *Specular microscopy is used to view and record non-invasively the image of the corneal endothelial cell layer.*

Aim: *Study was undertaken to document the effect of cataract surgery on specular microscopic corneal status of patients in different age group.*

Material and Methods: *Four hundred fifty seven patients were included in this study, the patients who underwent cataract surgery. The patients were examined before surgery & after 6 weeks of surgery on follow up visits. Corneal endothelial examination was done with non-contact Specular Microscope (TopconSP-2000P) after detailed ocular examination.*

Results: *Cell loss after surgical trauma was seen in older age group (Table 11). Proportional Hexagonality analysis showed that the age groups 71-80 and > 80 years had more proportional Hexagonality change (Table 14).Proportional change analysis of mean Average Cell Size after cataract surgery in different age groups revealed that ACS increased significantly more in the higher age groups as compared to young patients($p<0.05$)(Table16). Postoperative CV increased across all age groups indicating polymegathisn.(Table 17). Pre and post CCT showed that older corneas had significantly more corneal swelling postoperatively.*

Conclusion: *To conclude in absence of significant corneal changes the visual recovery after cataract surgery was satisfactory.*

Keywords: *Specular microscopy, Corneal endothelium, Cataract surgery.*

INTRODUCTION

Specular microscopy is used to view and record non-invasively the image of the corneal endothelial cell layer [1,2]. The clinical specular microscopes are all based on the laboratory microscope designed by Maurice [1] to provide a high magnification view of specular reflected light from the corneal endothelium. The specular reflex occurs at a regular, smooth surfaced interface of two refractive indices with the light from the subject having an angle of incidence equal to the angle of reflection to the observer. The endothelial cells can be imaged because the refractive index of the endothelial cells is greater than the 1.336 value for aqueous humor, thus reflecting 0.022% of the projected light [3]. Early reports from 1920 describe the use of specular reflex light with the slit lamp to view the corneal endothelium [4].

Normal Endothelial Cell Layer Morphology; When the human corneal endothelium is damaged the healing is a process of cellular enlargement and spreading to create a contiguous layer of cells on the inner surface of the cornea. The degree of endothelial cell loss from disease, trauma, chemical toxicity, etc can be documented with specular microscopy as an increase in individual cell surface area and a decrease in the endothelial cell density for the cornea. The corneal endothelial cell wound repair is also reflected as an increase in the variation of individual cell areas, i.e. Polymegethism or Coefficient of Variation (CV). Six-sided cells are an indication of an even distribution of membrane surface tension and of normal cells. The polygon that has the greatest surface area relative to its perimeter is the hexagon. Thus, the most efficient cell shape to cover a given area is the hexagon; i.e. a perfect cornea should have 100% hexagons [5]. The normal cornea can be expected to have 60% of the endothelial cell as hexagons. Stress to the endothelial cells will result in a decrease from the normal 60% distribution of 6 sided cells to a lesser percentage. The endothelial cell morphology analysis includes: Cell Area ±S.D(μm^2), Cell Density (cells/mm^2), Polymegethism (coefficient of variation, CV), and Pleomorphism (% of 6 sided cells). The cell density is determined from the average cell area with the following relationship in equation 1.

$$\text{Cell density} = \frac{106}{\text{Average cell area}}$$

With cell density (cell per mm^2), average cell area (μm^2), and the value 10^6 is used to convert units of measure.

The patient's corneal endothelium consists of cells of varying surface areas. The polymegathism value is a coefficient describing the variation in cell area. As the standard deviation of the average cell area increases, the accuracy of the estimated true cell density decreases. Therefore, increases in polymegathism causes a decrease in the accuracy of the average cell area. Polymegethism is defined by the coefficient of variation (CV) value determined with equation 2.

$$CV = \frac{SD\,cell\ area\ mean}{cell\ area, \mu m2}$$

With CV as coefficient of variation and
SD as standard deviation of the mean cell area.

Long-term contact lens wearers and diabetic patients develop corneal endothelial cell polymegathism while still retaining normal cell density for their age[6,7,8,9,10,11,12].

Change in Endothelial Cell Density with Age;

The topic of corneal endothelial cell loss in normal subjects with increasing age is of great concern when designing a clinical trial to assess the affects of a drug or surgical procedure on the corneal tissue. The consistent consensus is that a gradual decrease in cell density occurs with increasing age [13,14 ,15 ,16]. Armitage et al [17], the cell loss is bimodal with 0 to 20 years demonstrating a more rapid cell loss per year than subject > 20 years old. The data graphed in had a 0.22% cell loss per year between 17 and 83 years (n=78). The decrease has been reported by Yee et al 1985 ,as 0.3% cell loss per year between 10 and 89 years of age (n=60). Moller-Pedersen[18] determined the cell loss for patients >14 years of age to be 0.3% per year (n=178). Bourne et al [19] re-photographed two sets of patients after a 10 year period. The authors grouped the patients who were <18 years old (5 to 15 years, n=10) and >18 years old (n=42). The younger patient cohort had a 1.1% ±0.8% per year loss in endothelial cell density; the older patient cohort had 0.6%±0.5% per year loss.

This study was undertaken to document the effect of cataract surgery on specular microscopic corneal status of patients in different age group.

MATERIAL AND METHOD

Four hundred fifty seven patients were included in this study, conducted in department of Ophthalmology, KasturbaHospital, Mahatma Gandhi Institute of Medical Science (MGIMS) Sevagram, undertaken on the patients who underwent cataract surgery between January 2004 To December 2004. The patients were examined before surgery & after 6 weeks of surgery on follow up visits. Corneal endothelial examination was done with non-contact specular microscope (TopconSP-2000P) after detailed ocular examination.

The following specular morphological parameters were quantitated. (figure.1)

ECD(Endothelial Cell Density) was estimated by counting endothelial cell number by a computer assisted measuring system after counting 20 cells in a cluster. ECD is one of the indices. It was measured in cells/mm^2.

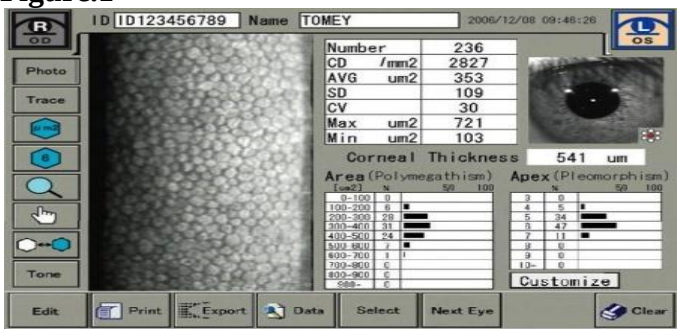
H(Hexagonality): difference in the shape of endothelial cells are commonly investigated by assessing the proportion of cells that are six sided("percentage of hexagonality").the variation of cell shape or pleomorphism is an indicator of corneal health The percentage of hexagonal cell is a quantitative measure of pleomorphism. It was given as %.

CCT(Central Corneal Thickness)in the specular microscopy: the thickness of the cornea is measured by focusing the device on the epithelial and endothelial surfaces on the cornea, this is done automatically in the noncontact Specular microscope (Topcon SP 2000P) used and digital read out is displayed. It was measured in µ.

Average cell size, the maximum and minimum cell area gives the range of variation in cell size. It was measured in μm^2.

Coefficient of Variation, the maximum and minimum cell area gives the range of variation in cell size.

Figure.1-



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Out of 457 eyes included in the study extra capsular cataract extraction with Posterior chamber intra – ocular lens implantation (ECCE with PCIOL) was done in 422 (92.3%) eyes. Anterior Chamber Intraocular lens implantation (ACIOL) was done in 26(5.7%) eyes and in 9(2%) eyes with myopia/subluxated lens extra capsular Cataract Extractions (ECCE) was done without IOL implantation.

RESULT AND OBSERVATION

Demographic profile of patients; Age and Sex.

The mean age of patients was 67.3 years. The eldest patient in this study was 91 years of age and the youngest patients was 13 years old. Majority of the patients 256(56.050 were in the age group 61-70years. Nine (2%) patients were below 40 year of age and seven (1.5%) were aged more than 80 years.

Out of 457 patients, 242(53%) were male and 215(47%) female. There was no significant difference in the age distribution of male and female patients. Mean age was 67.6 years for males and 67.1 years for females (Table.1).

Table 1: Age and Sex Distribution

Age Group (Years)	Males No. (%)	Female No. (%)	Total No. (%).
<40	7(77.7) (2.8)	2(22.3) (1.0)	9(2.0)
41-50	8(66.7) (3.3)	4(33.3) (1.9)	12(2.6)
51-60	22(46.8) (9.1)	25(53.2) (11.6)	47(10.3)
61-70	117(45.7) (48.3)	139(54.30) (64.7)	256(56.0)
71-80	85(67.5) (351)	41(32.5) (19.1)	126(27.6)
>80	3(42.9) (1.4)	4(57.1) (1.9)	7(1.5)
TOTAL	242(53.0) (100.0)	215(47.0) (100.0)	457(100.0)

Specular Microscopic Characteristics of Cornea in Different Age Group;

Endothelilal Cell Density (ECD) - Distribution of mean endothelial cell density of operated and fellow eyes in different age group shows that there is a gradual decline in preoperative endothelial cell

density with increase in age. No significant difference in mean endothelial cell density was noted between the two eyes of a patient (p value > 0.05). (Table.2)

Table 2: Distribution of mean endothelial cell density (ECD) of operated and fellow eyes in different age group.

Age Group (Years)	Number of Patients	Mean ECD in Operative eye (cells/mm2)	Mean ECD in Fellow eye (cells/mm2)
<40	9	2789.7	2812.6
41-50	12	2556.3	2514.1
51-60	47	2421.1	2402.3
61-70	256	2439.2	2314
71-80	126	2288.7	2293.2
>80	7	2104.6	2110.1

Out of 457 eyes included in the study group 343 (75.1%) had endothelial cell density ranging from 2001-3000 cell/mm$^{2.}$. The minimum endothelial cell density noted was 1127 cell/mm^2 and maximum endothelial cell density noted was 3593 cells/mm^2. The mean preoperative endothelial cell density was 2406.8 ±440.9 cell/mm^2. The mean endothelial cell density of fellow eye was 2424.3 ± 405 cells/mm^2.

Hexagonality- Out of 457 eyes included in the study group 393 (86%) eyes showed hexagonality in more than 20% of the cell in the central cornea. haxagonality range from 10 – 65%.(Table.3)

Table 3: Distribution of eyes according to Hexagonality (%) of cells.

Percentage of cells with Hexagonality	No. of eyes (%) (n=457)
0-10	1(0.2)
11-20	63(13.8)
21-30	176(38.5)
31-40	154(33.7)
41-50	51(11.2)
51-60	11(2.4)
61-70	1(0.2)

The hexagonality gradually decreased with the increase age indicating increasing pleomorphism with age. No significant different was found between mean hexagonality of cells in the two eyes of a patient. The preoperative mean hexagonality of operated eyes was 30.5%±8.9. (Table.4)

Table 4: Mean Hexagonality (H) of endothelial cells in operated and fellow eyes in different age group.

Age Group (year)	Number Of Patients	Operated Eye Mean H (%)	Fellow Eye Mean H (%)
<40	9	39.4	37.1
41-50	12	35.1	35.3
51-60	47	34.2	33.9
61-70	256	30.4	29.1
71-80	126	29.2	28.6
>80	7	29.7	28.4

age. No significant difference in mean average cell size was noted between the two eyes of a patient (p > 0.05).

Table 5: Mean average cell size (ACS) of endothelial cell in operated and fellow eyes in different age group

Age Group (Year)	Number Of Patients	Operated Eye Mean ACS (µM2)	Fellow Eye Mean ACS (µm2)
<40	9	376	322.7
41-50	12	401	386.1
51-60	47	426.3	438.4
61-70	256	420	471.3
71-80	126	455.6	506.6
>80	7	427.4	523.6

In the study group, the mean preoperative average cell size was 429.2 µm^2 ± 93.3, the mean average cell size of fellow eyes was 422.2 ± 84.4 µm^2. The difference was not statistically significant. Average cell size (ACS) showed a gradual increase with the increase age in both eyes. Distribution of eyes according to average cell size ranged from 285 µm^2 to 851 µm^2. Out of 457 eyes included in the study 421 (92.2%) eyes had average cell size in the range of 301 µm^2,out of which 189 (41.4%) eyes showed Average cell size (ACS) in the range of 301 – 400 µm^2.(Table 6).

Table 6) :Distribution of operated eyes according to average cell size (ACS).

ACS (μm^2)	No. of Eyes (%) n= 457
201-300	10(2.2)
301-400	189(41.4)
401-500	184(40.3)
501-600	48(10.5)
601-700	17(3.7)
701-800	6(1.3)
801-900	3(0.7)

Coefficient of Variation (CV) In Cell Size - Difference in maximum and minimum cell area denotes variation in cell size (polymegathism). Coefficient of variation (CV) in cell size is calculated by dividing the standard deviation of the cell area by the mean cell area. It is a dimensionless index which gives a measure of polymegathism. Secular microscopy of the central cornea revealed that the mean coefficient of variation (CV) in cell size for the operated eyes was 22.5 ± 4.3. Mean coefficient of variation (CV) in cell for the fellow eyes was 23.3 ± 5.2. On statistical analysis it was found that both eyes showed no signification difference ($p > 0.05$). (Table7).

Table 7. Mean coefficient of variation (CV) of endothelial cells in operated and fellow eyes in different age groups.

Age Group (Year)	Number Of Patients	Mean CV Operated Eye	Mean CV Fellow Eye
<40	9	20.2	20
41-50	12	22.3	19
51-60	47	22.7	21.2
61-70	256	23.4	23
71-80	126	24	23
>80	7	27.3	26.7

Out of 457 eyes included in the study 397 (86.9%) of eyes showed mean preoperative coefficient of variation (CV) in cell size the range of 11 – 30. (Table 8)

Table 8. Distribution of eyes according to Coefficient of variation (CV) in cell size.

Preoperative CV	No. of eyes(%) n=457
11-20	157(34.4)
21-30	240(52.5)
31-40	55(12.0)
41-50	5(1.1)

Central Corneal Thickness (CCT) - The mean central corneal thickness (CCT) of operated eyes was 547µ ± 33.6 and 549µ ± 3.2.4µ in the fellow eyes. There was no statistically significant difference between central corneal thicknesses(CCT) of both the eyes of the patient (p value > 0.05). There was a tendency towards slight increase of central corneal thickness (CCT) in different age group which was not statistically significant. (Table 9)

Table 9. Distribution of Mean central corneal thickness (CCT) in operated and fellow eyes in different age groups.

Age group (year)	Number of patients	Mean CCT(µ) operated eye	Mean CCT (µ) Fellow eye
<40	9	513.2	508.4
41-50	12	531.3	530.2
51-60	47	546.6	546.7
61-70	256	559.1	562.8
71-80	126	574.3	573.1
>80	7	583.9	581.7

The minimum central corneal thickness (CCT) was 501 µ and maximum central corneal thickness (CCT) was 592 µ. (Table 10)

Table 10. Distribution of eyes according to central Corneal Thickness (CCT).

Preoperative CCT (µ)	No. (%)
451-500	242(53.0)
501-550	144(31.5)
550-600	70(15.3)
600-650	1(0.2)
Total	457(100.0)

Specular microscopic changes in corneal status after cataract surgery in different age groups;
Endothelial Cell Density (ECD)- The mean postoperative endothelial cell density of the operated eyes was found to be 2043.0 cell/mm^2 ± 508.6 postoperative maximum endothelial cell density recorded was 569 cells/mm^2 and maximum endothelial cell density was 3358 cells/mm^2. The endothelial cell density was less in older age group 61-70 & 71-80 year. Mean postoperative endothelial cell density was found to be 2053 cells/mm^2 in 61-70 year and 1916.1 cells/mm^2 in the age group 71-80 year. The average decrease was 595cells/mn^2. (Table 11)

Table 11. Mean endothelial cell density (ECD) Pre and Post cataract surgery in different age groups.

Age Group (Year)	Number of patients	Mean pre-op ECD (cells/mm2)	Mean post-op ECD (cells/mm2)
<40	9	2789.7	2632.2
41-50	12	2556.3	2378.4
51-60	47	2421.1	2159.9
61-70	256	2439.2	2053
71-80	126	2288.7	1916.1
>80	7	2504.6	1909.6

On analysis the preoperative and post operative endothelial cell count, we found decrease in endothelial cell count postoperative in all the age groups. Proportional cell loss was statistically significant only in the older age group i.e.51-80 year (p value < 0.05). Proportional cell loss was statically significant in the younger aged patients < 50 year (p value 0.05) as can be seen in (Table 12). Greater mean cell loss was found ranging from 386.2 to 372.6 in age group 61 to 80 year implying a greater cell loss after surgical trauma in older age group. Maximum change in mean ECD was seen in the age group of > 80 year (595 cells/mn^2) reflecting that older corneas suffered more cell loss after surgical trauma

Table 12. Change in endothelial cell density (ECD) after cataract surgery in different age groups.

Age group (year)	Number of patients	Changes in Mean ECD (cells/mm2)	Propational cell loss	P value
<40	9	206.4	7.5	0.72
41-50	12	177.8	7	0.29
51-60	47	248.5	10.3	0.004
61-70	256	386.2	15.8	0
71-80	126	372.6	16.3	0
>80	7	595	23.8	0.05

Hexagonality (H) - The postoperative mean Hexagonality was found to decrease after cataract surgery in all age groups, indicating cell loss after surgery leading to polymorphism. The mean postoperative Hexagonality was 25.6% ± 9.2. Change in hexagonality (percentage of six–sided cells) was most in the age group > 80 (7.4%). (Table 13)

Table 13. Mean hexagonality (H) pre and post Cataract surgery in different age groups.

Proportional hexagonality analysis showed that the age group 71-80 and > 80 year had more proportional hexagonality % change (p value > 0.05). (Table 14)

Age group (year)	Number of Eyes	Pre-Op Mean Hexagonality H (%)	Post-Op Mean Hexagonality H (%)
<40	9	39.4	35.1
41-50	12	35.1	27.8
51-60	47	37.2	27.5
61-70	256	30.4	25.6
71-80	126	29.2	24.2
>80	7	29.7	22.3

Table 14. Change in Mean hexagonality(H) after cataract surgery in different age groups.

Age group (year)	Number of patients	Changes in mean hexagonality (%)	Propational h(%) change	P value
<40	9	4.3	10.9	0.06
41-50	12	7.3	2.1	0.02
51-60	47	4.7	12.6	0.01
61-70	256	4.9	16.1	0

71-80	126	5.2	17.8	0
>80	7	7.4	24.9	0.01

Average Cell Size (ACS) - Mean Average cell size (ACS) was found to increase postoperatively in all the age groups (Table24). The mean postoperative Average Cell Size (ACS) was 521.0 μm^2 ± 174 as compared to preoperative mean Average cell size (ACS) of 429.2 μm^2 ± 93.3. The maximum Average Cell Size (ACS) found postoperatively was 99 μm^2 and maximum ACS was 1529 μm^2.

Proportional change analysis of mean ACS after cataract surgery in different age group revealed that ACS increase signification more in the higher age group as compared to the young patients. (Table16). This indicates that decrease in cell density postoperatively leads to more in ACS postoperatively in older corneas. (Table 15)

Table 15. Mean average cell size (ACS) Pre and Post cataract surgery in different age group.

Age group (year)	Number of eyes	Pre-Op Mean ACS (µM2)	Post-Op Mean ACS (µM2)
<40	9	376	447.8
41-50	12	401	441.4
51-60	47	426.3	484
61-70	256	420	57505
71-80	126	455.6	557
>80	7	427.4	557.4

Average cell size was found to increase postoperatively in all age group showing a decrease in endothelial cell density after cataract surgery.

Table 16. Change in mean average cell size (ACS) after cataract in different age group.

Age group (year)	Number of patients	ACS Change (µm2)	Proportional ACS Changes	P value
<40	9	-71.9	19.1	0.03
41-50	12	-40.5	10.1	0.23
51-60	47	-57.6	13.5	0.006
61-70	256	-95.3	22.7	0
71-80	126	-102.3	22.5	0
>80	7	-130	30.4	0.12

Coefficient Of Variation (CV) In Cell Size - The mean postoperative coefficient of variation (CV) was 25.48 ± 7.4 as compared to preoperative CV of 22050 ± 4.3 the minimum coefficient of variation (CV) being 8 & maximum 52. Postoperatively coefficient of variation (CV) was found to increase showing polymegathism in all the age groups. (Table 17)

Table 17. Mean coefficient of variation (CV) in cell size Pre and Post cataract surgery in different age group.

Age group (year)	Number of Eyes	Pre-Op Mean CV	Post-Op Mean CV
<40	9	20.2	22.8
41-50	12	22.3	23.1
51-60	47	22.7	24
61-70	256	23.4	25.9
71-80	126	24	27
>80	7	27.3	26.7

Centeral Corneal Thickness (CCT) - The mean postoperative central corneal thickness (CCT) in the operated eyes was observed to be 568 µ ± 32.3. Preoperatively, the mean central corneal thickness of the central cornea: The minimum central corneal thickness (CCT) was 501 µ and maximum central corneal thickness (CCT) was 592µ. It showed a tendency towards slight increase with the age which was not clinically significant. (Table 18)

Table 18. Mean Central corneal thickness (CCT) Pre and Post Cataract surgery in different age group.

Age group (year)	Number of Eyes	Pre-Op Mean CCT (µ)	Post-Op Mean CCT(µ)
<40	9	513.2	529.8
41-50	12	531.3	548.2
51-60	47	545.6	560.1
61-70	256	559.1	578.2
71-80	126	574.3	591.2
>80	7	583.9	602.7

On proportional change analysis central thickness after cataract surgery showed an increase in mean central corneal thickness. The change was found to be statistically significant in 51 – 80 year indicating that as the cornea ages, the ability of endothelium to withstand surgical stress decreases. (Table 19)

Table 19. Change in mean central corneal thickness (CCT) after cataract surgery in different age group.

Age group (year)	Number of Eyes	Postoperative CCT Change (µ)	Proportional CCT Change	P value
<40	9	16.6	0.032	0.43
41-50	12	16.9	0.032	0.35
51-60	47	14.5	0.027	0.005
61-70	256	19.1	0.034	0.001
71-80	126	16.9	0.027	0.002
>80	7	18.8	0.032	0.94

DISCUSSION

Endothelial Cell Density (ECD) - In the present study mean post operative ECD of the operated eyes was found to be 2043.0 ± 508.6 cell/mm^2 as compared to 2406.8 ± 440.9 cell preoperatively. Greater mean cell loss ranging from 386.2 to 372.6 was found in the age group 61 – 80 years. Mean post operative ECD in age group 61 – 70 year was found to be 2053 cell/mm^2 and 1916.1 cell/mm^2 in age group 71 – 80 years. More cell loss after surgical trauma was seen in older age group.

Hexagonality- In the present study means postoperative Hexagonality was 2.56% ± 9.9 as compared to mean preoperative Hexagonality of 30.5% ± 9.2. Statistically significant change in Hexagonality was seen in the age group 41 to 80 indicating increased pleomorphism after surgical trauma. (pvalue < 0.05) (Table 14). Change in mean Hexagonality after cataract surgical in different age group showed significant loss of hexagonality postoperatively in all age group indicating that surgical trauma induces piemorphism (Table 14). Proportional Hexagonality analysis showed that the age group 71 – 80 and > 80 year had more proportional Hexagonality change.

Average Cell Size (ACS) - In the present study mean postoperative ACS was 521.0 ± 174 µ m^2 as compared to 429.0 ± 93.3 µm^2 preoperatively. After cataract surgery the ACS was found to increase in all age group (Table 15). proportional change analysis of mean average cell size after cataract surgery in different age group revealed that ACS increase significantly more in the higher age group as compared to the young patients (p<0.05).

Coefficient of Variation (CV) In Cell Size - In the present study postoperative mean CV in cell size was 25.48 ± 7.4 as compared to mean preoperative coefficient of several of 22.5 ± 4.3. Minimum CV was 8 and maximum CV was 52 in our postoperative cataract patient. Postoperative CV increased across all age groups indicating polymegathism.

Central Corneal Thickness (CCT) - In the present study postoperative mean CCT in operated eyes was observed to be 568.0 ± 32.3 µ as compared to 547.0 ± 33.6 µ preoperatively (Table 18). Difference in CCT was not found to be statistically significant (p>0.05). Post operatively mean CCT increased across all age group but it was more in the older eyes(p value < 0.05) indicating that older eyes showed more corneal swelling postoperatively.

Bourne et al (2004) examined 239 patients preoperatively and post-operatively, the initial mean preoperative cell count was 2481 cell /mn^2 which reduced post-operatively to 2239 cell/mn^2. An average 9.8% reduction in cell count was noted after one year. No such change was noted in Hexagonality, Coefficient of Variation and Central Corneal Thickness. [20]

Studies reported from 1977 to 1980 documented average endothelial cell losses after IOL insertion from 23% to 46%. Studies reported from 1980 and 1981 report cell losses less than 20%, Improvement fostered by refined IOL design, more appropriate case selection, modification in surgical technique and Healon.

Ventura et al (2001) reported significant endothelial cell loss after cataract surgery in all patients; the mean cell loss being 146 cell / mm^2 (p=0.01). [21]

Hirst et al (1977) found an average corneal endothelial cell loss of 14% after IOL implantation and 13% mean cell density loss in routine cataract patients. Bourne et al (2004) showed an endothelial cell loss of 500 cell / mn^2. [22]

In a study by **Kraff et al** (1980) the mean endothelial cell loss with IOL implantation ranged from 15.8 to 20.9% and least average endothelial cell loss with ICCE (12.6%) which was not significantly differently from PC-phaco (15.2%). [23]

Binkhorst et al (1978) and Liesegang et al reported continued cell loss upto 10 years after ICCE and ECCE. [24]

Kraff et al (1982) found a mean endothelial cell loss of between 11.6% and 21.4%, when comparing cell densities measured preoperatively and those taken within 2.12/2 & 6 months after implant surgery. [25]

CONCLUSION

Cell loss after surgical trauma was seen in older age group(Table 11). Proportional hexagonality analysis showed that the age groups 71-80 and > 80 years had more proportional Hexagonality change (Table 14). Proportional change analysis of mean average cell size after cataract surgery in different age group revealed that ACS increased significantly more in the higher age groups as compared to young patients($p<0.05$)(Table16). Postoperative CV increased across all age groups indicating polymegathism.(Table 17). Pre and postoperative CCT showed that older corneas had significantly more corneal swelling postoperatively. To conclude, in absence of significant corneal changes the visual recovery after cataract surgery was satisfactory.

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