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Endothelial cell changes after small incision cataract surgery in diabetic and non-diabetic patients: A cohort study

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Abstract
Cornea of diabetic patients is exposed to increased glucose concentration which contributes to the accumulation of advanced glycation end products, on the basement membrane lamina. Reduced corneal endothelial cell density and swelling of the cornea are indicators of corneal dysfunction and there is evidence that patients with diabetes mellitus have some functional corneal abnormalities. There is a paucity of data from India on the effects of small incision cataract surgery on the corneal endothelium, therefore this study will give us an insight and better understanding of the methods to adapt while operating to prevent the endothelial cell loss.
Objectives: To assess the endothelial cell changes and central cornel thickness pre operatively and post operatively in patients with type II diabetes mellitus and age matched individuals after Manual Small Incision Cataract Surgery.
Methods: It is a hospital based prospective cohort study done on 60 eyes of sixty diabetic patients and 60 eyes of age matched individuals who underwent small incision cataract surgery. The endothelial cell density, coefficient of variation, hexagonality and the central corneal thickness was measured at regular intervals on post operative day 1, week 1, week 4 and week 8.
Results: Statistical significance in reduced ECD, increase in the coefficient of variation and central corneal thickness post operatively in diabetics when compared to age matched controls. Endothelial cell loss was independent of the duration and severity of diabetes.
Conclusion: The decrease in the endothelial cell density, reflects that surgical trauma is more in diabetic patients than normal individuals.

Keywords: Small incision cataract surgery, trabeculectomy, glaucoma, intraocular pressure

Introduction
Diabetes mellitus is a global epidemic with significant morbidity. Diabetic retinopathy remains a leading cause of preventable blindness in developing countries [1]. Prevalence of diabetes worldwide was estimated to be about 4% in 1995 but its incidence has increased considerably [2]. Diabetes mellitus may be defined as a primary disorder of carbohydrate metabolism, secondarily involving the protein and fat metabolism characterized by hyperglycaemia and glycosuria [3]. It occurs when the pancreas is not able to produce enough insulin or the body becomes resistant to insulin, or both, resulting in increased blood glucose levels. This may lead to micro and macro-vascular disorders, which in turn result in changes in corneal endothelial cell density (ECD) and corneal thickness [4].
Cornea of diabetic patients is exposed to increased glucose concentration which contributes to the accumulation of advanced glycation end products, on the basement membrane lamina [5]. Reduced corneal ECD and swelling of the cornea are indicators of corneal dysfunction and there is evidence that patients with DM have some functional corneal abnormalities [6]. In the diabetic corneal endothelium, sorbitol accumulation within cells and a decrease in Na+/K+ ATPase activity induce dysfunction of the corneal endothelium cell layer leading to corneal hydration which translates to increased CCT measurements. Thus, cornel thickness indirectly informs about the functioning of the endothelial layer [7].
Cataract surgery is one of the primary causes of endothelial cell loss as a result of intraoperative manipulations [8]. Manual small incision cataract surgery is preferred (generally accepted) as it is economical and less technology dependent when compared to phacoemulsification. SICS is useful in dense cataracts which are frequently seen in India [9].

There is a paucity of data from India on the effects of SICS on the corneal endothelium, therefore this study will give us an insight and better understanding of the methods to adapt while operating to prevent the endothelial cell loss [10].

Aim and objectives of the study

To assess the endothelial cell changes and the central corneal thickness pre operatively and post operatively in patients with type II diabetes mellitus and age matched individuals after Small Incision Cataract Surgery.

Materials and Methods

This study was conducted on patients visiting the outpatient department of ophthalmology in Vydehi Institute of Medical Sciences and Research Center for cataract surgery who are diabetic and non-diabetic from January 2018 to May 2021. This was a hospital based prospective cohort study. The study consisted of two groups of 60 cases in each. All the patients satisfied the inclusion and exclusion criteria. Group I (the study population) consisted of diabetic patients with age- related cataract and group II (the reference population) consisted of non-diabetic patients with age-related cataract. Detailed history and examination were done for all the study participants. An informed written consent was taken from all the patients.

Inclusion Criteria: Patients between the age group of 45 years to 70 years with Type II diabetes mellitus with senile cataract were the study group. Reference population included non-diabetics with senile cataract. The patients had age related cataract as per LOC III classification of GRADE I-IV Nuclear Sclerosis, all Posterior Subcapsular cataract and cortical cataract.

Exclusion Criteria: Other types of cataract other than age related cataract, history of previous intraocular and refractive surgery, Glaucoma, Uveitis, High myopia, any condition that impeded corneal evaluation by specular microscope/pachymetry (Fuch's dystrophy), Conjunctival scarring diseases, intra-operative complications such as posterior capsule rent, vitreous loss, pseudoexfoliation syndrome, collagen vascular diseases, preoperative endothelial cell count less than (1500cell/mm^2), contact lens wearers, diabetic macular oedema, patients who are on prolonged topical ocular medications and patients who have undergone laser treatment for diabetic retinopathy were excluded from the study.

Sample size: Sample size for comparing 2 means was used. Using the results of the study showing changes in corneal endothelial cell density in patients with diabetes was used to calculate sample size for comparing means between the groups. Sample size was calculated by using the Mean Endothelial cell count at 12 weeks from the study using these values at 95% Confidence limit and 80% power sample size of 50 was obtained in each group. With 10% nonresponse sample size of 60 + 5.0 ≈ 65 cases will be included in each group [4].

The following investigations and interventions were done on diabetic patients in case group and participants on control group:

1) **BCVA:** Visual acuity was checked in all patients using snellen's chart (with and without pinhole)
2) **Slit Lamp Biomicroscopy:** For detailed anterior segment evaluation.
3) **Intraocular Pressure:** Using Goldmann's Applanation Tonometer
4) **Direct/Indirect Ophthalmoscopy:** Was done using 90D/78D for detailed posterior segment evaluation.
5) **B-Scan:** In mature cataract for posterior segment evaluation.
6) **Specular Microscopy:** (Using Model CELLchek SL Premier Endothelial Analytics) Quantitative examination was done for the following parameters: Corneal endothelial cell density (mm^2), Co - efficient of variation (polymegathism), Number of cells, Hexagonality (%) (polymorphism), Central corneal thickness (microns)
7) Grading of cataract using LOC III classification was done
8) **Blood Investigations:** CBC, Serology (HIV, HBsAg), FBS, PPBS, HbA1C (this value gives us an insight to the average sugar level in the body for last 3 months)

All patients underwent Manual Small Incision Cataract Surgery (MSICS). All eyes were pre dilated with tropicamide 0.8% and phenylephrine 5% and homatropine 2% eye drops. Surgeries were performed under peribulbar anaesthesia using 5ml (3ml+2ml) of 2% lignocaine and 0.5% bupivacaine in ratio of 1:1 with 150 units of hyaluronidase. A fornix based conjunctival flap was superotemporal and bleeding was cauterized with bipolar cautery as required. Surgery was done through a 6.5mm frown sclera incision. Sideport was made at 9 '0 Clock position. Hydroxy propylmethyl cellulose (2%) was injected to fill the anterior chamber. Continuous curvilinear capsulorrhexis was done using a 26-gauge bent needle. Entry was made into the anterior chamber using a keratome. OVD injected into the anterior chamber. Hydrodissection was done using balanced salt solution and the nucleus was cartwheeled into the anterior chamber. The viscoelastic was injected above and below the lens to protect the endothelium. The nucleus was delivered using a vectis. The cortical matter was removed using irrigation and aspiration cannula. After which the polymethylmethacrylate posterior chamber intraocular lens was implanted into the capsular bag. AC irrigated prior to ending the surgery subconjunctival injection was given into the inferior fornix. All surgeries were done by one surgeon using the same OVD, BSS and the PMMA lens was implanted into the bag in all patients.

The cell density, coefficient of variation, hexagonality and central corneal thickness were measured at regular intervals on post operative day 1, week 1, week 4 and week 8.

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables. Paired t test is the test of significance for paired data such as before and after surgery for quantitative data. Graphical representation of data was done using MS Excel and MS word. p value (Probability that the result is true) of <0.05 was considered as statistically

significant after assuming all the rules of statistical tests. MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Results

There was no statistical significance with age among both the groups. Mean age of cases was 60.5 ± 6.9 years and controls 61.0 ± 5.9 years. With respect to gender, among cases, 55% were males and 45% were females and among controls, 51.7% were females and 48.3% were males. In cases, 46.7% of operated eyes were on left side and in 53.3% operated eye was on right side. In controls, 48.3% of operated eyes were on left side and in 51.7% operated eye was on right side. There was no significant difference in operated eye between two groups. Right eye, among cases and controls majority of subjects were diagnosed to have NS II (40% and 43.3% respectively). There was no significant difference in diagnosis between two groups. Left eye, among cases and controls majority of subjects were diagnosed to have NS II (33.3% and 45% respectively). There was no significant difference in diagnosis between two groups. In cases, 46.7%
of operated eyes were on left side and in 53.3% operated eye was on right side. In Controls, 48.3% of operated eyes were on left side and in 51.7% operated eye was on right side. There was no significant difference in Operated eye between two groups.

Table 1: Comparison of visual acuity pre and post operative between two groups

		Group				P value
		Cases		Controls		
		Count	%	Count	%	
Pre-op Visual Acuity	6/18	30	50.0%	38	63.3%	0.205
	6/24	18	30.0%	11	18.3%	
	6/36	6	10.0%	8	13.3%	
	6/60	3	5.0%	3	5.0%	
	CF 6 MTS	3	5.0%	0	0.0%	
Post-op Visual Acuity	6/12	15	25.0%	4	6.7%	0.006*
	6/9	45	75.0%	56	93.3%	

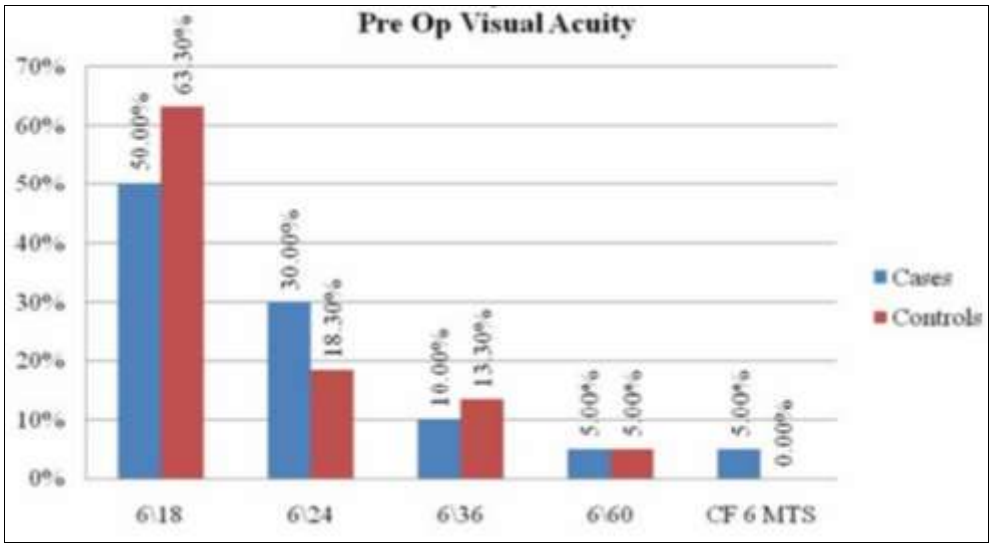

Fig 1: Bar diagram showing Preoperative visual acuity comparison between two groups

In preoperative period, among study group majority had visual acuity 6/18 (50%) and among controls majority had visual acuity of 6/18 (63.3%). In Post Op period, among study group majority had VA of 6/9 (75%) and among controls majority had VA of 6/9 (93.3%).

Table 2: Duration of Diabetes among cases

		Group	
		Cases	
		Count	%
Duration of Diabetes	<5 years	17	28.3%
	6 to 10 years	23	38.3%
	>10 years	20	33.3%

Among study group, 28.3% had diabetes for <5 years, 38.3% had for 6 to 10 years and 33.3% had for >10 years.

Table 3: Diabetic Retinopathy among cases

		Group	
		Cases	
		Count	%
Diabetic Retinopathy	No DR	34	56.7%
	Mild DR	9	15.0%
	Moderate DR	15	25.0%
	Severe DR	2	3.3%

Among cases, 56.7% had no Diabetic retinopathy, 15% had Mild DR, 25% had moderate DR and 3.3% had Severe DR. Mean HbA1c % was 6.6 ± 0.8. In the diabetic group, indicating a good compliance with the antidiabetic treatment. HbA1c was in average measured during the study, which reflects the glucose level for a period of 3 months, in the diabetic group.

Table 4: Cell density comparison between two groups at different intervals of follow up in Operated Eye

	Group				P value
	Cases		Controls		
	Mean	SD	Mean	SD	
Pre-Op	2440.1	239.7	2669.5	230.9	<0.001*
Day 1	2414.9	241.6	2629.2	225.9	<0.001*
Week 1	2390.5	239.0	2620.9	223.3	<0.001*
Week 4	2368.4	238.9	2615.4	220.7	<0.001*
Week 8	2348.2	237.2	2615.4	220.7	<0.001*

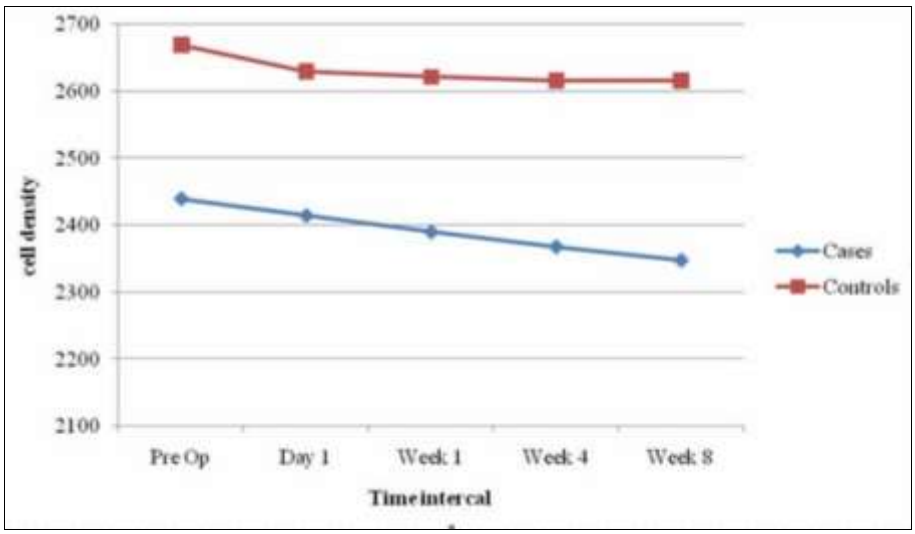

Fig 2: Line diagram showing cell density comparison between two groups at different intervals of follow up in operated eye

Mean cell density was significantly higher in Control group than in study group at all the intervals of follow-up (from preoperative period to postoperative week 8). Therefore, there was significant endothelial cell loss among cases and controls at all intervals of follow up.

Table 5: Comparison of the endothelial cell loss from the pre operative period to post operative period in CASES.

No	Cases	Mean	P value
60	Pre-op ECD 2440.1	239.7	0.0367
	Post-op ECD 2348.2	237.2	

The ECD in the cases pre operative was 2440.1 with mean SD 239.7 and post operative ECD was 2348.2 with mean SD being 237.2. The mean endothelial cell loss was statistically significant among the study group from pre op to post op period with p value 0.0367.

Table 6: Comparison of the endothelial cell loss from the pre operative period to post operative period in controls

No	Controls	Mean	P value
60	Pre-op ECD 2669.5	230.9	0.1912
	Post-op ECD 2615.4	220.7	

The ECD in controls pre operatively was 2669.5 with mean SD 230.9 and post operative ECD was 2615.4 with mean SD 220.7. The mean endothelial cell loss was not statistically significant among the controls from pre op to post operative period with p value 0.1912.

Table 7: Correlation between Duration of DM and Endothelial Cell Count on different periods of follow-up in study group

	Duration of Diabetes	Pre-op	Day 1	Week 1	Week 4	Week 8
Pearson Correlation	1	0.233	- 0.055	0.019	0.128	- 0.017
P value		0.074	0.679	0.884	0.331	0.899
N	60	60	60	60	60	60

In the study group, there was no significant correlation between duration of DM and Endothelial cell count from preoperative period to week 8 postoperative period.

Table 8: Comparison between Diabetic Retinopathy and Endothelial Cell Count on different periods of follow-up in study group

	Diabetic Retinopathy								P value
	No DR		Mild DR		Moderate DR		Severe DR		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Pre-op	134.35	11.57	140.22	14.93	136.13	12.62	142.00	2.83	0.545
Day 1	135.21	10.04	134.78	14.11	133.67	11.54	136.00	4.24	0.973
Week 1	136.38	10.88	141.56	9.32	136.53	12.29	133.50	3.54	0.599
Week 4	136.56	10.22	139.22	13.24	140.07	9.09	136.50	12.02	0.713
Week 8	135.47	10.46	140.00	9.50	135.73	11.31	122.00	5.66	0.189

In the study there was no significant difference in mean endothelial cell count with respect to Diabetic retinopathy among cases at all the intervals of follow-up.

Table 9: Coefficient of variation comparison between two groups at different intervals of follow-up in Operated Eye

	Group				P value
	Cases		Controls		
	Mean	SD	Mean	SD	
Pre-op	31.4	3.7	32.5	4.2	0.136
Day 1	35.5	5.6	30.4	2.6	<0.001*
Week 1	33.9	5.0	32.3	2.3	0.023*
Week 4	34.2	6.1	32.2	2.4	0.021*
Week 8	33.2	4.8	30.8	3.2	0.002*

Mean coefficient of variation was significantly higher in study group than in controls from day 1 postoperative period to postoperative week 8.

Table 10: Hexagonal cells comparison between two groups at different intervals of follow-up in operated eye

Hexagonal		Group			P value
	Mean	SD	Mean	SD	
Pre-op	40.9	7.6	41.5	7.7	0.685
Day 1	41.8	7.4	41.5	7.2	0.773
Week 1	41.8	7.4	42.0	6.8	0.888
Week 4	42.9	7.5	40.9	7.3	0.147
Week 8	41.4	6.5	– 41.4	7.0	0.989

There was no significant difference in mean percentage of hexagonal cells between two groups from preoperative to postoperative (8 weeks) period.

Table 11: Endothelial cell count comparison between two groups at different intervals of follow-up in operated eye

Endothelial Cell count	Cases	Group	Controls		P
	Mean	SD	Mean	SD	value
Pre-op	135.9	12.2	135.5	12.8	0.867
Day 1	134.8	10.8	136.9	13.2	0.350
Week 1	137.1	10.9	133.6	11.2	0.083
Week 4	137.8	10.3	133.7	12.3	0.05
Week 8	135.8	10.7	132.4	11.1	0.088

There was no significant difference in mean endothelial cell count between two groups from pre-operative to postoperative 8 weeks period. Endothelial cell loss was initially higher in controls later from 1st week Post operatively, the endothelial cell loss was higher in study group.

Table 12: Central corneal thickness comparison between two groups at different intervals of follow-up in operated eye

CCT	Group				
	Mean	SD	Mean	SD	P value
Pre-op	484.7	34.6	490.2	32.3	0.366
Day 1	511.1	35.6	520.7	28.8	0.108
Week 1	538.6	29.5	526.1	28.5	0.021*
Week 4	568.3	24.3	529.8	28.1	<0.001*
Week 8	591.7	20.8	527.2	28.3	<0.001*

There was no significant difference in Mean Central corneal thickness between two groups from Preoperative to postoperative day 1 but it was seen that there was significant difference in mean central corneal thickness between cases and controls from week 1 to week 8 and CCT was higher in study group.

Discussion

The cornea, transparent avascular structure acts as structural barrier which protects the eye from infections. The corneal endothelium is a single layer that is 5µ thick structure which is very important in maintaining the corneal transparency. Diabetic corneas undergo morphological changes due to the the intracellular accumulation of polyol by aldose reductase which causes swelling of the endothelial cells due to its osmotic property. This study was primarily aimed at comparing the corneal endothelial cell density, co efficient of variation, hexagonality and central corneal thickness in patients with age related cataract having type-II diabetes mellitus and age matched controls. The demographic data of two groups are summarized.

Among the cases, 56.7% had no diabetic retinopathy, 15% had mild DR, 25% had moderate DR and 3.3% had severe DR which was insignificant and endothelial cell parameters did not show any significance in relation to age, gender duration of diabetes, severity of diabetic retinopathy and the HbA1C value. There have been studies which have evaluated the differences of the corneal factors between normal people and diabetic but studies on relevance of the duration of diabetes to the corneal parameters are rare.

In our study, the mean ECD in diabetic patients pre operative was 2440.1 $\pm$ 239.7 ($p< 0.001$) being significant and in control group ECD 2669.5 + 230.9 ($p< 0.001$), this showed that even in the preoperative period the diabetic patients had reduced endothelial cell count when compared to control group. Postoperatively, ECD 2348.2 $\pm$ 237.2 in cases and in controls ECD 2615.4 + 220.7 ($p< 0.001$) in both groups which signifies there was considerable amount of endothelial cell loss in both groups, more significant in study group at all intervals of follow up post operatively.

In this context, we also compared the ECD pre operatively and post operatively among the study group, the results were significant with p value = 0.0367. This proved that diabetic patients had significant endothelial cell loss from the pre operative to post operative period following MSICS, whereas among the control group it was insignificant with p value 0.1912. The total endothelial cell loss in cases was 3.76% and in controls was 2.02%. In diabetes, the activity of Na+/K+AT Pase of the corneal endothelium is reduced causing morphological and permeability changes in the cornea. 7 Evaluation of the endothelial cell morphology reflects the quantitative property and also provides a qualitative description of the functional status in terms of variation and cell area and cell shape. A reduction of cell count that is not detectable with cell density measurements can be detected by quantization of the CV, the percentage of hexagonal cells and the CCT. On correlating the endothelial cell count loss with the duration of diabetes post operatively in cases there was no significant endothelial cell loss among the cases at all intervals of follow up and likewise when the severity of diabetic retinopathy was compared with the amount of endothelial cell loss the values were statistically insignificant. This shows that endothelial cell loss in not related to the duration of diabetes and is independent of the severity of diabetic retinopathy. Pre operatively there was no difference in the mean co efficient of variation among both the groups (p = 0.136). The mean co efficient of variation was significantly higher in cases than in controls from post operative day 1 to post operative week 8. ($p< 0.002$).

With regard to the corneal endothelial morphology, the coefficient of variation in cell size appears to be the most sensitive of the three factors. This likely suggest that polymegathism and pleomorphism may precede a decrease

in cell density. There was no difference in the percentage of hexagonality among the cases and controls from the preoperative period to postoperative period. A study done by Renu Dhasmana *et al.* showed in the post operative period diabetics had significantly higher endothelial loss (14.19%) when compared to non-diabetics (8.05%).

There was also significant increase in CCT and the change in the percentage of hexagonal cells in diabetics (p= 0.004).11 In our study we did not find the CCT to be significant pre operatively and on post op day 1 in both the group but there was significant difference in mean central corneal thickness between cases and controls post operatively from week 1 to week 8 [Table 12]. CCT was higher in cases on regular intervals of follow ups which indicated that CCT was significantly high in diabetics. This proves that it takes more time in diabetics for corneal oedema to resolve as repair process is slow and they have distinct morphological difference when compared with normal corneas. A study done by Allan Storr *et al.* showed there was no difference in the ECD, CV or the hexagonality but there was significant increase in CCT in diabetics when compared to non- diabetics [8]. Keoleian *et al.* reported that patients frequently had abnormal corneal endothelium in contrast to normal individuals which explained that the corneal endothelium of diabetic patients had structural disorder but the functional disorder of the corneal tissues was not affected [12].

Busted *et al.* showed that diabetic corneal thickness was significantly higher, but there was no significant relation between the CCT and duration of diabetes. A more active compensation of the corneal endothelial pump actions seems to be present in the younger diabetics because of which the corneal thickness of diabetics depends on the increased hydration of the cornea [13].

Ziadi *et al.* reported that it took longer for diabetic to recover from damaged corneal tissues when compared to normal individuals. A stimulus like stress, trauma or lack of oxygen supply can cause functional disturbances in the corneal tissues. Therefore, it is very important to observe and examine the functional parameters of the corneal tissue while taking up the patient for any ophthalmological procedure such as cataract, refractive surgeries [14].

Studies done by Lee *et al.* and Ranganath *et al.* reported lesser number of endothelial cell in diabetics as compared to non-diabetics. 7.15 A recent study conducted in southern India with a large sample size showed that the mean endothelial cell density was significantly lower across all age group of patients with diabetes compared to controls [9].

Mathew *et al.* conducted a study on MSICS in diabetic patients which showed decreased endothelial count in diabetics at 3 months in the post operative period. The endothelial loss in control group was 16.58+12.9% and 19.24+11.57% in diabetics. The diabetic group however had a higher mean pre operative endothelial count compared to control group in this study. They noted no statistically significant change in co efficient of variation. Percentage of change in hexagonality cells was not reported in their study.16 Similarly, Mikkel Hugod *et al.* reported that the corneal endothelial cell loss in diabetics as compared to non-diabetic patients 3 months post cataract surgery with IOL implantation was significantly higher [17]. Corneal endothelial cell loss is a well-known side effect of cataract surgery. The extent of endothelial cell damage during a cataract surgery depends on the incision type, OVD used, composition of the irrigating fluid and active manipulation of the nucleus in the anterior chamber.

On the basis of our study, diabetics have morphological and functional abnormalities like increased CCT, decreased endothelial cell density, increased co efficient of variation.18 Endothelial cell loss is related to corneal endothelial cell modelling after the trauma to the eye post-surgery than to the ongoing age-related cell loss [19].

MSICS has become a popular cost-effective suture less surgery providing early visual rehabilitation [14]. After every type of cataract surgery with or without IOL implantation, the corneal endothelial cell count is diminished. Several studies have indicated an increased corneal vulnerability in diabetic subjects to intraocular surgical stress. It is likely that this phenomenon occurs because of chronic metabolic changes on the cellular level that primarily is seen to affect the monolayer of corneal endothelial cells.

Conclusion

India is considered the diabetic capital of the world, and a significant proportion of patients undergoing cataract surgery are diabetics. Eyes of diabetic patients show more severe corneal endothelial damage following cataract surgery and delayed recovery of corneal oedema. Most studies have highlighted that there is endothelial cell loss in patients post operatively as any intraocular procedure is an insult to the eye. When compared to normal individuals the diabetic patients had decreased ECD, increased CV and CCT which says that the diabetic corneas are prone to endothelial damage and have a delayed recovery phase post operatively. Endothelial cell loss was insignificant when it was correlated with the duration of diabetes and severity of diabetic retinopathy.

Modern surgical and pharmacological techniques allow safer and more effective surgery in diabetic individuals. Proper case selection, adequate pre operative evaluation and diligent surgical techniques are essential to maintain a clear cornea. Better understanding of the preoperative, intraoperative and postoperative factors can help us get a favourable outcome of cataract surgery in diabetic patients and guide us in an overall management of these patients to get optimized results. Therefore, we conclude that the decrease in the endothelial cell density, reflects that surgical trauma is more in diabetic patients than normal individuals. MSICS is a safe technique in diabetics with acceptable endothelial cell loss. The change in morphology is associated with the process of repair is altered in diabetic patients in spite of having a good glycaemic control.

In conclusion, ECD is reduced in both the groups after cataract surgery, as there was increased CCT in both diabetics and controls in the post operative period from week 1 to week 8, more significantly high in diabetic patients. There was evidence of increased CV in post operative period in the diabetic patients which implies the corneal endothelial cells had features of polymegathism but there was no significant change in the hexagonality in both the groups in the post operative period.

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