Original Article

Clinical Evaluation of Corneal Endothelium and Central Corneal Thickness Before and after Cataract Surgery

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ABSTRACT

Introduction: Preservation of corneal endothelial function is a major goal in cataract surgery as it plays an important role in maintaining the corneal transparency and visual outcome. This study compared the morphological features of corneal endothelium and central corneal thickness (CCT) before and after cataract surgery.

Objective: To compare the corneal endothelium morphology and central corneal thickness before and after cataract surgery.

Methodology: This was hospital-based, prospective, observational study conducted at Nepal eye hospital within six months period from September 2022 to February 2023 considering inclusion and exclusion criteria before and after cataract surgery, that is Phacoemulsification. Consecutive sampling technique was utilised and ethical approval was taken. Corneal endothelial cell characteristics: endothelial cell density, coefficient of variability, percentage of hexagonality, and central corneal thickness were taken before the surgery and then first week and six weeks after cataract surgery.

Result: Among the 63 patients were who underwent cataract surgery the mean age was 69.81±9.2 years with male:female ratio of 31:32. The mean CCT preoperatively, first week, and six weeks after surgery were 536.06±34.3, 536.46±41.9, and 523±37.9 respectively which suggest slight borderline statistical difference in CCT preoperatively and at six weeks. The endothelial loss at first week follow-up was 22.5% and the preoperative hexagonality was 64.83± 6.56, and at one week follow up the hexagonality decreased to 62.14± 6.99 which was statistically significant. The endothelial cell loss at six week follow up was 24.8%, polymegathism was increased and percentage of hexagonality had decreased.

Conclusion: Endothelial cell alteration after surgery is important parameter for estimation the safety of surgical technique. The study concluded that there were changes in corneal endothelial morphology and central corneal thickness before and after cataract surgery.

Keywords: Corneal endothelium cells; central corneal thickness; phacoemulsification; specular microscopy.

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INTRODUCTION

Corneal endothelium consists hexagonal cells responsible for maintaining the desiccation of the stroma which plays a pivotal role in maintaining the transparency of the cornea (Tufft and Coster, 1990). The corneal endothelial cells are very sensitive to trauma which can decrease cell density (CD) and alter the cell morphology. Endothelial cell loss (ECL) during surgery affects the functional capacity of the cornea to maintain transparency, with subsequent visual deterioration. The corneal tissue which is the mainstay of post-operative clarity depends on undisturbed cell morphology and sufficient CD. So, the post-operative corneal endothelium CD is a useful indicator of damage caused by surgical procedures (Eghrari et al, 2015; Kobayashi et al, 2002). Specular microscopy is the study of corneal layers under very high magnification which is 100 times greater than slit lamp biomicroscopy. It is mainly used to assess the endothelium, in terms of cellular size, shape, density, and distribution. It can be used to evaluate the corneal endothelium density and morphology before and after intraocular surgery (Salmon, 2019). Corneal thickness is an index for corneal hydration and metabolism and also an indicator of corneal endothelium pump patency. Measurement of corneal thickness also helps to determine the corneal health (Barr, 2021). World Health Organisation estimates 47.8% of global blindness is due to cataract (Murthy et al., 2008). Preservation of corneal endothelial function is a major goal in cataract surgery which is important in maintaining the corneal transparency (Ventura et al., 2001). There are many studies done in different countries to corroborate the importance of specular microscopy for the evaluation of corneal endothelium before and after cataract surgery (Bamdad et al., 2018; Chauhan et al. 2019).

This study aims to evaluate the corneal endothelial cell changes and central corneal thickness before and after cataract surgery in a tertiary eye hospital of Nepal.

METHODOLOGY

This was a prospective observational analytical study conducted at Nepal Eye Hospital between 2022 September to 2023 February. The ethical clearance was taken from Institutional Review Board of National Academy of Medical Science (NAMS), Mahabouddha, Kathmandu, Nepal (Reference number: 38/2080/81). Consecutive patients undergoing Phacoemulsification surgery performed by single surgeon in the study duration and meeting the inclusion criteria were taken for the study. Preoperative cataract grading by LOCS III classification was done and nucleus sclerosis grades 1-4, all cortical cataract grades and all posterior sub capsular grades were included. The following were the exclusion criteria: 1) Patients with traumatic cataract or complicated cataract, 2) Hypermature / mature senile cataract, 3) Patients with Corneal pathology, Glaucoma, Uveitis, Pseudoexfoliation syndrome, 4) Patients with previous intraocular surgery, 5) Preoperative endothelial cell count of <1500 cells/mm2, 6) Small pupil diameter after a full dilatation of less than 4 mm, 7) Patients with shallow anterior chamber, and 8) Patients who has lost follow-up visits.

A detailed history and comprehensive ophthalmic examination was performed on all participants, including visual acuity, thorough

anterior segment examination was performed using a slit lamp. Preoperative central corneal thickness and specular microscopy findings were noted by using noncontact specular microscope (Topcon SP - 3000P) microscope at a resolution of 640 x 480 pixels. All patients were operated under local anaesthesia using anaesthetic solution lignocaine 2% and bupivacaine 0.5% with hyaluronidase 5 IU/ml mixed with 1 in 1 lac adrenaline.

Surgical procedure: Phacoemulsification was performed where a 2.8-3.3 mm superotemporal clear corneal incision was given and a self-sealing tunnel was made. Anterior chamber was entered with the help of a 3.2 mm keratome and was maintained using the viscoelastic hydroxypropyl methylcellulose. Continuous curvilinear capsulorrhexis was done with a capsulorrhexis forcep which was followed by hydrodissection and hydrodelineation. Sideport was made two to three clock hours away from main port to provide entry to the second instrument used to manipulate the lens. Nucleus was emulsified in posterior chamber which was followed by removal of endonucleus. Cortex and epinucleus were aspirated. Foldable posterior chamber IOL was implanted and dialed, intracameral moxifloxacin and stromal hydration was done to prevent wound leak. Subconjuctival gentamycin and dexamethasone was given. Patch and bandage was done.

Post-operative corneal thickness, endothelial cell density, endothelial cell loss, coefficient of variability, hexagonality was measured at one week and six weeks follow up visit.

Statistical analysis was done by using descriptive and inferential statistics using Student's paired t-test and software used in the analysis was IBM SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, N.Y., USA) and $p < 0.05$ is considered as the level of significance.

RESULT

Among the sixty-three patients were who underwent cataract surgery the mean age was 69.81± 9.2 with male: female ratio of 31:32.

Out of the 63 patients in this study, 32 patients (50.79 %) were male and 31 patients (49.20%) were female as shown in (Table 1).

Although there was slight changes in central corneal thickness at first week and six weeks but not statistically significant (Figure 1).

There was a significant difference in the mean endothelial cell density between the preoperative and 6th week post-operative measurements (Table 2).

The change in coefficient of variation is not statistically significant (Table 3).

The change in percentage of Hexagonality between preoperative and at first and six week post-operatively was significant (Table 4). The mean Phacoemulsification Time was 15.51±21.79.

There was positive correlation between phacoemulsification time and central corneal thickness (CCT) at fourth week post-operatively (Table 5).

Table 1: Demographic profile of patients.

Parameters		Frequency (Percent)
Age (in years)	50-60	9 (14.28)
	61-70	24 (38.09)
	71-80	25 (39.68)
	>80	5 (7.93)
Gender	Male	32 (50.79)
	Female	31 (49.20)
Laterality	Right	38 (60.31)
	Left	25 (39.68)

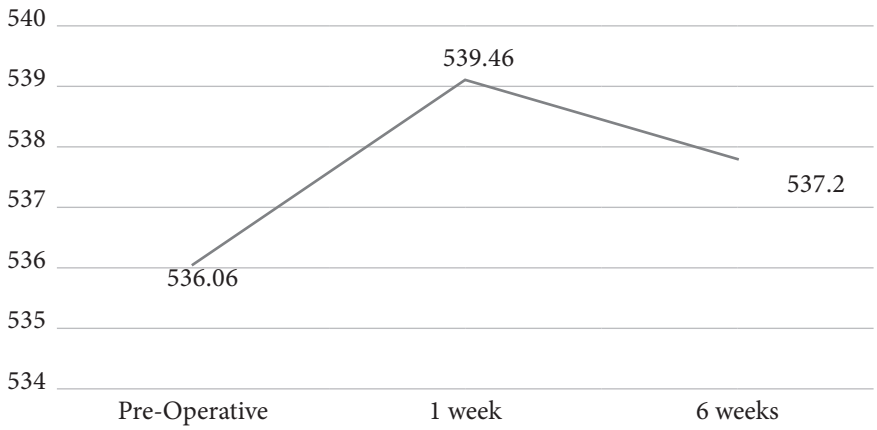

Figure 1: Progression of central corneal thickness before and after surgery.

Table 2: Comparison of Endothelial cell density at post-operative first week and six weeks with preoperative cell count.

Endothelial cell density (ECD)	Mean ± Standard Deviation	Percentage	p-value
Preoperative	2670.11 ± 294.58		
1st week	2469.10 ± 663.73	7.52	0.12
6th Week	2225.60 ± 448.40	16.66	0.000

Table 3: Comparison of Coefficient of variation at Post-operative 1st week and 6th week with Preoperative value.

Coefficient of Variation (CV)	Mean ± Standard Deviation	Percentage	p-value
Preoperative	33.44 ± 4.49		
1st week	33.75 ± 8.64	0.31%	0.81
6th week	34.85 ± 8.01	1.4%	0.18

Table 4: Comparison of Percentage of Hexagonality at post-operative 1st week and 6th week with preoperative value.

Percentage of hexagonality (%HEX)	Mean ± Standard Deviation	Percentage	P-value
Preoperative	64.83 ± 6.56		
1st week	62.14 ± 6.99	2.69%	0.016
6th week	61.89 ± 5.65	2.94%	0.011

Table 5: Correlation of endothelial cell parameters and central corneal thickness with Phacoemulsification time at six weeks post-operative.

		Phacoemulsification time	
		Pearson's Correlation	P-value
Endothelial cell density (ECD)	6th week post -operative	0.063	0.712
	ECD change	-0.087	0.610
Coefficient of Variation (CV)	6th week post-operative	-0.034	0.840
	CV change	-0.106	0.534
Percentage of Hexagonality (% HEX)	6th week post-operative	-0.040	0.814
	%Hexa change	-0.020	0.906
Central corneal thickness (CCT)	6th week post-operative	0.315	0.057
	CCT change	0.226	0.178

DISCUSSION

This study included 63 patients where the mean age of patients was 69.81± 9.2 years whereas the other study shows the mean age was 62.1±12.2 which signifies our study had older age group participation (Bamoda et al., 2018). The preoperative mean central corneal thickness was 536.46± 34.33 which was similar to other studies that showed that the mean preoperative

central corneal thickness was 541.9 ± 33.3.19 and 542.62 ± 43.11 respectively (Morikubo et al., 2004; Lin et al., 2014). In this study the mean CCT on 1st week post-operatively increased from 536.06 baseline to 539.46 and on 6th week post-operatively was 537.22 which shows slight change in thickness but it was not statistically significant. Deshpande et al., (2018) study found the mean CCT on post-operative day 7th increased from 518.46 baseline CCT to 533.78 and on

post-operative day 30th was 524.9 which was statistically significant, similar to this study. Preoperative mean endothelial cell density in our study was 2670.11 ± 294 followed by 2469 ± 662, and 2225.60 ± 448 at one week and 6th week post-operatively. The endothelial cell density has decreased by 7.52% at one week and 16.66% at 6th week post-operatively which was statistically significant. However study done by Chauhan et al., (2019) observed endothelial cell density had decreased by 2.14% and 4.24% at 1st and 8th week after surgery. The difference may be due to the variation in phacoemulsification time and difference in grades of cataract. Current study shows the preoperative coefficient of variation was 33.44±4.49 and at 6th week post-operative 34.85±8.01 which showed 1.4% increment from the baseline. Similarly, Budiman et al., (2020) assessed changes in coefficient of variation on follow up of 4th week post-operatively and found that there was an increase in the coefficient of variation, 38.1 ± 7.5 ,1 % increase which is similar to this study findings. The percentage of hexagonality at 6th week post-operative was 61.89± 5.65 that is 2.94% decrease from the preoperative value (64.83± 6.56). Budiman et al., (2020) and Morikubo et al., (2004) also reported mean hexagonality at the end of post-operative 4th week had decreased as compared to preoperative value 50.1 ± 14.5 (2 %) and 57.2 ± 10.4 (1.6 %) respectively. Their findings were found to be similar to present study findings though Yang et al., (20110 study was different from current study, 48.6 ± 8.58 (6.7 %). Pearson's correlation studies were done to find out the relationship between the energy used during phacoemulsification and the various endothelial parameters. As shown in (Table 5) there were no significant correlations between phacoemulsification time and the endothelial cell parameters (ECD, CV, %Hex) changes after surgery but, there was positive correlation between phacoemulsification time and central corneal thickness (CCT) at 6th week post-operatively. However the study done by Sahu et al., (2017) showed significant positive correlation to all the four endothelial cell parameters at three months post-operative period in non- diabetic patients.

CONCLUSION

Endothelial cell alteration after surgery is important parameter for estimating the safety of surgical technique. Central corneal thickness increased initially after surgery followed by gradual decrease of thickness but it didn't return to preoperative value and also showed positive correlation with phacoemulsification time. There was significant decrease in percentage of hexagonality after the surgery. The limitations of the study are it included only one technique other technique may have given different results, and large sample size with longer follow up period would have been better.

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