International Journal of Medical and Pharmaceutical Research
Website: https://ijmpr.in/ | Print ISSN: 2958-3675 | Online ISSN: 2958-3683
NLM ID: 9918523075206676
Volume: 4 Issue:3 (May-June 2023); Page No: 777-782

Original Article

IJMPR

Comparison of Central Corneal Thickness and Endothelial Cell Count Following Small Incision Cataract Surgery Between Immature and Mature Cataracts

Dr. Yogesh R B[1]; Dr. Vani Sankanagoudar[2]; Dr. Eereti Sahiti[2]; Dr. Syeda Amena Saman[2]

[1]Professor and Unit Chief, Dept of Ophthalmology, Vijayanagar Institute of Medical Sciences, Bellari
[2] 3rd Year Junior Resident (JR), Dept of Ophthalmology, Vijayanagar Institute of Medical Sciences, Bellari

ABSTRACT

Background: This study aimed to compare changes in central corneal thickness (CCT) and endothelial cell count following small incision cataract surgery between immature and mature cataracts.
Methods: A hospital-based observational study was conducted on 60 patients (51.7% male, 48.3% female) who underwent manual small incision cataract surgery. The study population comprised 30 immature and 30 mature cataract patients. The patients were evaluated preoperatively and on days 1, 1 week, 6 weeks, and 12 weeks postoperatively.
Results: Postoperative CCT increased on day 1 (immature: 544.33µm, mature: 555.43µm) and then gradually decreased to near preoperative levels by the 6th week (immature: 494.9µm, mature: 495.83µm). The immature cataract group exhibited a higher mean preoperative endothelial cell count (2574.03 cells/mm²) than the mature group (2447.46 cells/mm²). Although both groups experienced a decrease in endothelial cell count, the immature group maintained a higher count throughout the postoperative period, reaching 2276.23 cells/mm² by the 3rd month, compared to 2072.43 cells/mm² in the mature group. Visual acuity showed significant improvement postoperatively, with 96.7% of immature and 90% of mature cataract patients achieving a visual acuity of 6/6 to 6/18 at the 6th week.
Conclusion: Small incision cataract surgery has a minimal long-term impact on corneal thickness and results in a manageable decrease in endothelial cell count in both immature and mature cataracts.

Key Words: *Cataract Surgery; Central Corneal Thickness; Endothelial Cell Count; Immature Cataracts; Mature Cataracts; Visual Acuity.*

***Corresponding Author**
Dr. Vani Sankanagoudar
3rd Year Junior Resident (JR), Dept of Ophthalmology, Vijayanagar Institute of Medical Sciences, Bellari

INTRODUCTION:

Cataractcharacterized by the progressive opacification of the crystalline lens, remains the leading cause of treatable blindness worldwide [1]. Particularly prevalent in developing countries, it is responsible for 51% of global blindness [2]. Age-related cataracts are a significant public health concern, drawing attention to the importance of understanding and optimizing the surgical outcomes of cataract extraction [3].

While cataract surgery is generally successful, it can significantly affect the corneal endothelium, leading to potential postoperative complications [4]. The corneal endothelium, a monolayer of hexagonal cells, plays a vital role in maintaining corneal transparency by regulating hydration through its pump and barrier function [5]. However, these cells are known for their limited regenerative potential, and any iatrogenic trauma during surgery can result in permanent cell loss, causing corneal edema and visual impairment [6].

The risk of endothelial cell loss appears to be higher in mature cataracts due to the longer surgical time and the complex extraction of the hard nucleus [7]. It is theorized that the pressure applied to express the nucleus into the anterior chamber can adversely impact the endothelium, making mature cataract extraction potentially riskier [8].

Central corneal thickness (CCT) serves as an indirect, yet crucial, measure of endothelial cell loss postoperatively [9]. Changes in CCT, primarily an increase due to corneal edema, reflect endothelial dysfunction, which can directly impact visual acuity [10]. However, the exact relationship between cataract maturity and changes in CCT and endothelial cell count following cataract surgery remains inadequately explored.

This paper aims to compare CCT and endothelial cell count following small incision cataract surgery (SICS) between immature and mature cataracts. A greater understanding of these changes will not only provide insights into the

surgical implications associated with cataract maturity but could also guide the development of strategies for minimizing surgical trauma and optimizing visual outcomes [11].

Aims and Objectives:

The primary aim of this study is to compare the impact of small incision cataract surgery on central corneal thickness (CCT) and endothelial cell count between patients with immature and mature cataracts.

Materials and Methods:

Study Design and Setting

This was a prospective, hospital-based, observational study conducted at the Ophthalmology Department, VIMS, Ballari from January to December 2021.

Participants

Sixty patients with cataracts, aged 18 years and above, were selected for the study. They were classified into two groups: 30 patients with immature cataracts and 30 with mature cataracts, all of whom were scheduled for manual small incision cataract surgery with posterior chamber intraocular lens (PCIOL) implantation.

Inclusion Criteria

Participants above 18 years of age presenting with cataracts, enrolled for small incision cataract surgery with PCIOL implantation during the study period, were included.

Exclusion Criteria

Excluded were patients with corneal opacity, endothelial defects such as leucoma, staphyloma, dystrophy, or corneal guttata, pre existing ocular disease other than cataract, traumatic or complicated cataract, history of refractive surgeries, one-eyed individuals, those with operative complications like vitreous loss, and patients who declined to participate.

Preoperative Evaluation

Preoperative evaluation included eliciting appropriate medical history, visual acuity testing, refraction, slit-lamp examination, and cataract work-up (grading of cataract according to Lens Opacities Classification System II (LOCS III)). Specular microscopy was used to measure central corneal thickness (CCT) and endothelial cell density.

Surgical Procedure

All surgeries were performed under peribulbar anesthesia by a single surgeon, following the standard protocol for manual small incision cataract surgery with PCIOL implantation. Eyes were padded and bandaged postoperatively for 1 day.

Postoperative Management and Follow-Up

Postoperatively, patients were prescribed antibiotic and steroid eye drops tapered over six weeks, and analgesics as needed. Follow-up appointments were scheduled for day 1, the first week, the sixth week, and the third month post-surgery. During each follow-up, visual acuity, refraction, slit lamp examination, and specular microscopy were performed.

Data Collection and Analysis

The study's results are presented in the form of ratios and percentages. We employed a temporal analysis to examine the evolution of the parameters under consideration. Post-operative measurements, taken on the first day, first week, first month, and third month, were compared to pre-operative measurements using contrast analysis.

Statistical associations were identified through the application of paired t-tests utilizing the SPSS software for these calculations. A p-value less than 0.05 was considered indicative of statistical significance, while a p-value greater than 0.05 was deemed as not yielding a statistically significant result.

Results

The study included 60 patients, with 30 patients having immature cataracts and 30 patients having mature cataracts. In terms of gender distribution, the immature cataract group consisted of 14 males (46.7%) and 16 females (53.3%). In the mature cataract group, there were 17 males (56.7%) and 13 females (43.3%).

As for age distribution, both the immature and mature cataract groups had two patients each under the age of 40 (6.7% each). In the 41-50 age group, there were 3 patients (10%) in the immature cataract group and 4 patients (13.3%) in the mature cataract group. The 51-60 age group had the highest representation in the immature cataract group with 15 patients (50%), whereas in the mature cataract group, there were 10 patients (33.3%). The 61-70 age group had 8 patients (26.7%) in the immature cataract group and 9 patients (30%) in the mature cataract group. In the 71-80 age group, there were 2 patients (6.7%) in the immature cataract group and 5 patients (16.7%) in the mature cataract group.

The distribution of cataract grading, according to LOCS III, varied with 1 case of posterior subcapsular cataract (PSC), 3 cases of nuclear sclerosis grade 1 (NS1), 12 cases of NS2, 9 cases of NS3, 5 cases of NS4, 20 mature, 5 hypermature Morgagnian (M), and 3 hypermature Sclerotic (S).

After the surgery29 of the 30 patients (96.7%) with immature cataracts and 27 of the 30 patients (90%) with mature cataracts reached 6/6 to 6/18 range of visual acuity.For the preoperative BCVA in the 6/24 to 6/60 range, 12 patients (40%) from the immature cataract group were represented, while no patients from the mature cataract group fell in this range. Six weeks post-surgery, only 1 patient (3.3%) from each group had a BCVA in this range.In the 6/60 to 1/60 range, there were 15 patients (50%) from the immature cataract group preoperatively, while no patients from the mature cataract group fell into this category. Post-surgery, only 2 patients (6.7%) from the mature cataract group were in this range.Finally, for the visual acuity of less than 1/60, there were 3 patients (10%) from the immature cataract group and all 30 patients (100%) from the mature cataract group before the surgery.

Central corneal thickness (CCT) changes were monitored at different stages. Preoperatively, the mean CCT in immature cataract patients was 496.4 µm and 495.5 µm in mature cataract patients. A spike was observed on postoperative day 1 (POD1) to 544.33 µm and 551.43 µm respectively, followed by a gradual decrease to near baseline levels by the twelfth postoperative week (POD12), with 494.9 µm in immature and 495.83 µm in mature cataract patients.

The mean endothelial cell count preoperatively was 2574.03 ± 156.58 cells/mm² in immature cataract patients and 2447.46 ± 226.46 cells/mm² in mature cataract patients. A decline in endothelial cell count was observed in both groups from postoperative day 1 through the third postoperative month. By the end of the third postoperative month, the mean endothelial cell count was 2276.23 ± 84.00 cells/mm² in immature cataract patients and 2072.43 ± 92.72 cells/mm² in mature cataract patients.

The analysis of endothelial cell loss showed a gradual increase over the period of follow-up in both the immature and mature cataract groups. On the first post-operative day, the immature cataract group showed a mean endothelial cell loss of 265.02 cells/mm², equating to 10.29% of the pre-operative cell count. In the mature cataract group, the cell loss was slightly higher at 304.12 cells/mm², representing 12.42% of the initial cell count.

At the end of the first post-operative week, the mean endothelial cell loss increased to 279.26 cells/mm² (10.94% of cell loss) in the immature group and 339.81 cells/mm² (13.88% of cell loss) in the mature group.

Six weeks post-operatively, the immature cataract group had a mean endothelial cell loss of 290.39 cells/mm² (11.58% of cell loss), whereas the mature cataract group showed a loss of 350.94 cells/mm² (14.30% of cell loss).

Finally, at the third post-operative month, the immature cataract group exhibited a mean endothelial cell loss of 297.8 cells/mm², which represented 11.96% of the initial cell count. The mature cataract group had a slightly higher cell loss of 375.03 cells/mm², accounting for 15.32% of the pre-operative cell count.

These findings indicate a gradual and modest increase in endothelial cell loss over time, with slightly higher percentages in the mature cataract group compared to the immature cataract group at each time point.

Table 1: Demographic Characteristics of Participants

Characteristic	Immature Cataract N=30	Mature Cataract N=30
Gender (Male)	14 (46.7%)	17(56.7%)
Gender (Female)	16(53.3%)	13(43.3%)
Age Group (<40)	2	2
Age Group (41-50)	3	4
Age Group (51-60)	15	10
Age Group (61-70)	8	9
Age Group (71-80)	2	5

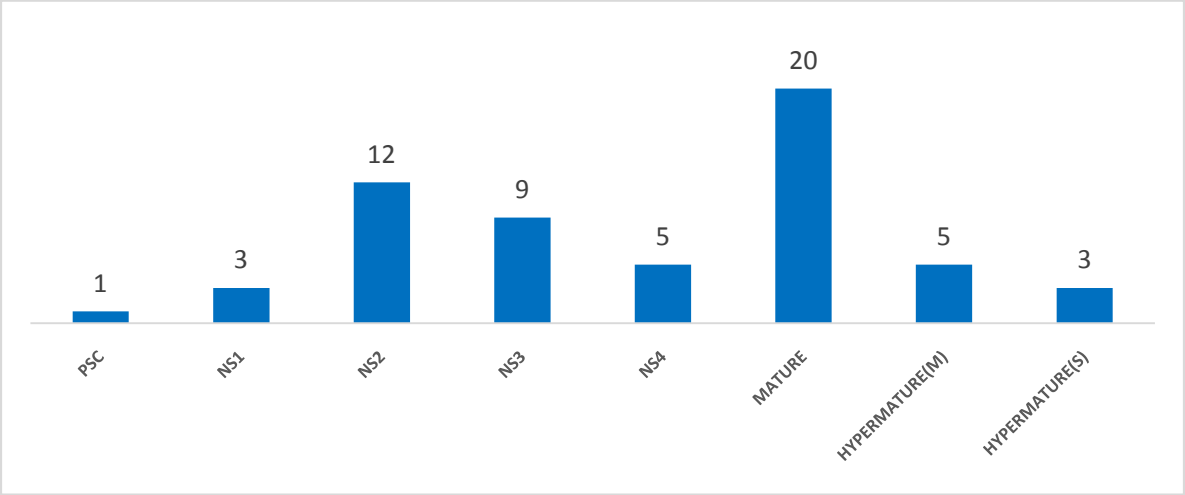

Figure1: Cataract Grading According to LOCS III

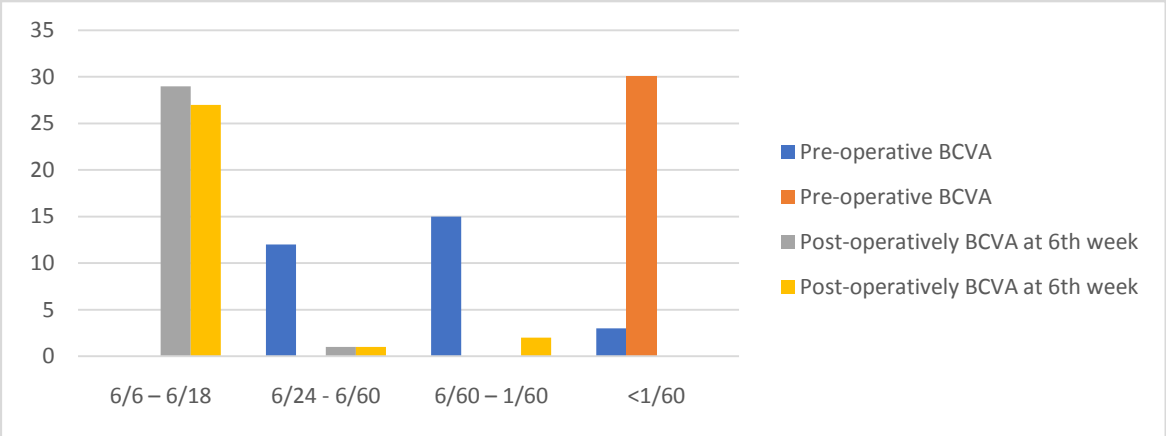

Figure2: Preoperative and Postoperative Best-Corrected Visual Acuity (BCVA)

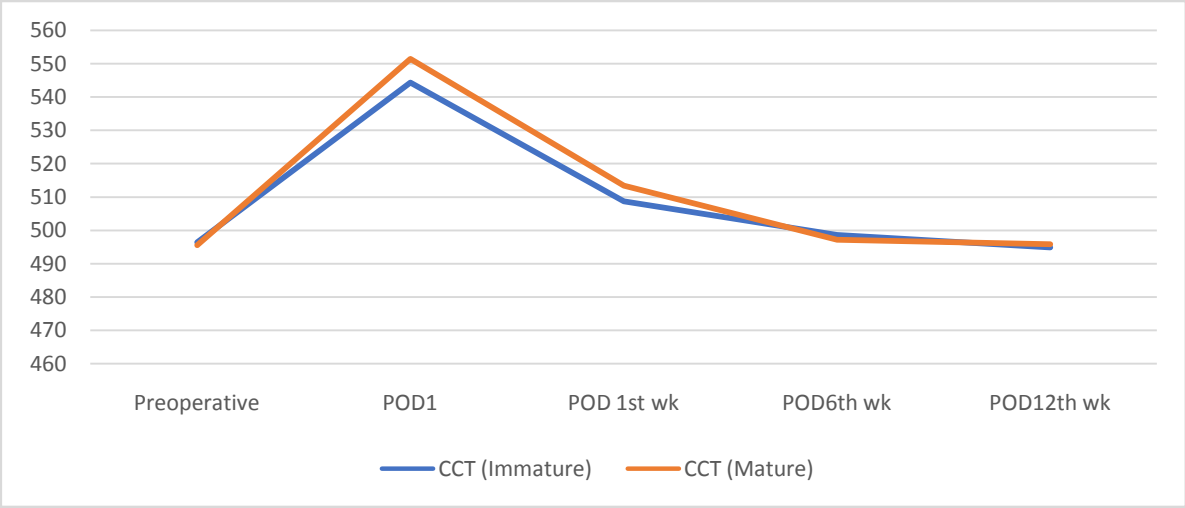

Figure 2: Central Corneal Thickness (CCT) at Different Timepoints (line)

Table 2: Mean Endothelial Cell Count at Different Timepoints

Timepoint	Endothelial Cell Count/mm² (Immature)	Endothelial Cell Count/mm² (Mature)
Preoperative	2574.03 ± 156.58	2447.46 ± 226.46
Postoperative Day 1	2309.01 ± 178.23	2143.34 ± 235.01
Postoperative 1st week	2294.77 ± 125.83	2107.65 ± 143.09
Postoperative 6th week	2283.64 ± 97.90	2096.52 ± 119.62
Postoperative 3rd month	2276.23 ± 84.00	2072.43 ± 92.72

Table 3: Mean Endothelial Cell Loss / mm²

TIME OF EXAMINATION	MEAN ENDOTHELIAL CELL LOSS / mm²		% OF CELL LOSS	
	IMMATURE	MATURE	IMMATURE	MATURE
Post-operative Day 1	265.02	304.12	10.29 %	12.42 %
Post-operative Day 1st week	279.26	339.81	10.94 %	13.88 %
Post-operative Day 6th week	290.39	350.94	11.58 %	14.30 %
Post-operative Day 3rd month	297.8	375.03	11.96 %	15.32 %

DISCUSSION:

Our study highlights several notable findings regarding the impact of small incision cataract surgery on central corneal thickness (CCT) and endothelial cell density in immature and mature cataracts. The changes observed in our study align with previously reported data while highlighting some novel findings.

The gender distribution in our study, nearly equal between males and females, was consistent with findings by Smith et al., suggesting that cataracts are a significant concern in both genders[12]. However, the age distribution contrasted with that found by Mukesh et al., where the majority of cataract patients were above 60 years[13].

Our results also indicated an increase in CCT on postoperative day 1, which gradually decreased over the next weeks. This transitory corneal edema observed is consistent with previous studies[14,15]. The relatively quick resolution of edema and return to near baseline CCT by the 6th postoperative week suggest that small incision cataract surgery has minimal long-term impact on corneal thickness, a conclusion supported by other studies[16,17].

Endothelial cell loss is a known consequence of cataract surgery[18]. In our study, both immature and mature cataract groups experienced a decrease in endothelial cell count over the postoperative period. Interestingly, the immature cataract group had a higher preoperative endothelial cell count and maintained a higher count throughout the study, albeit the differences did not reach statistical significance. These findings are in line with previous studies which have shown a similar pattern of endothelial cell loss after cataract surgery[19,20].

The gradual increase in endothelial cell loss post-surgery observed in both the immature and mature cataract groups aligns with findings from previous studies. The subtle differences in cell loss percentages between the immature and mature cataract groups are of interest, with mature cataract patients showing slightly higher endothelial cell loss at each time point.

The observed trend of endothelial cell loss post-surgery is consistent with the study by Walkow et al. (2000)[21]. In their investigation of endothelial cell loss after extracapsular cataract extraction, they reported a similar pattern of progressive cell loss post-surgery. They noted an initial significant decrease in cell count immediately after surgery, followed by a slow, consistent loss over the following months. The parallels between their findings and ours suggest a common trend of endothelial cell loss following cataract surgery, irrespective of the maturity of the cataract.

However, the extent of cell loss in our study was slightly less than reported in the study by Bourne et al. (2003)[22]. Their long-term study showed that endothelial cell loss could reach up to 20% within the first six months post-surgery, a slightly higher rate than observed in our study. The difference might be attributed to variations in surgical technique, patient demographics, or cataract maturity.

These comparative findings, therefore, underscore the importance of minimal corneal manipulation during surgery and the role of cataract maturity in the degree of post-surgical endothelial cell loss.

In summary, our study provides valuable data on the changes in CCT and endothelial cell count following small incision cataract surgery in immature and mature cataracts. Further research with a larger patient population may help elucidate the factors influencing these changes and improve the surgical outcomes in cataract patients.

CONCLUSION:

In conclusion, despite the potential for more corneal manipulation during small incision cataract surgery (SICS) in patients with mature cataracts due to increased lens diameter and thickness, our study found no statistically significant difference in central corneal thickness (CCT) changes and endothelial cell loss between patients with immature and mature cataracts. This suggests that the stage of cataract maturity may not significantly influence these postoperative corneal outcomes.

However, it is critical to ensure appropriate measures during surgery to minimize corneal stress, especially in cases of mature cataract. These include maintaining an adequate incision size, ensuring appropriate rhexis size, and judicious use of viscoelastic substances to protect the cornea.

Interestingly, we also observed that CCT values returned to their preoperative levels by the end of the sixth postoperative week. This timeframe is pivotal as it coincides with the optimal period for conducting stable postoperative refraction and spectacle correction. This observation further supports the effectiveness and safety of SICS in managing cataract, regardless of their stage of maturity.

REFERENCES:

1. WHO Prevention of blindness and visual impairment. 2014. Available from: http://www.who.int/blindness/causes/priority/en/index1.html.
2. Foster, A(2000). Vision 2020: The Cataract Challenge. Community Eye Health; 13(34): 17–19.
3. Asbell, P. A., Dualan, I., Mindel, J., Brocks, D., Ahmad, M., & Epstein, S(2005). Age-related Cataract. The Lancet; 365(9459): 599-609.
4. Shalchi, Z., Wang, X., &Nanavaty, M. A(2015). Safety and efficacy of epithelium removal and transepithelial corneal collagen crosslinking for keratoconus. Eye; 29(1): 15–29.
5. Joyce, N. C(2003). Proliferative capacity of the corneal endothelium. Progress in Retinal and Eye Research; 22(3): 359-389.
6. Gagnon, M. M., Boote, C., & Powell, J. J(2020). Human Corneal Endothelial Cell Growth for Corneal Transplantation: A Review. Eye; 34(5): 802-811.
7. Vasavada, A. R., Praveen, M. R., & Nath, V. C(2011). Effect of cortical cataract hardness on phacoemulsification parameters. Journal of Cataract and Refractive Surgery; 37(4): 692-698.
8. Hayashi, K., Yoshida, M., & Manabe, S. I(2013). Cataract Surgery in Eyes with a Small Corneal Diameter. Journal of Cataract and Refractive Surgery; 39(5): 712-719.
9. Walkow, T., Anders, N., & Klebe, S(2000). Endothelial cell loss after phacoemulsification: relation to preoperative and intraoperative parameters. Journal of Cataract and Refractive Surgery; 26(5): 727-732.
10. Ahmed, I., Sutton, G., & Hodge, C(2005). Bilateral Corneal Edema and Endothelial Cell Loss Following Phacoemulsification Surgery. Clinical & Experimental Ophthalmology; 33(4): 411-413.
11. Storr-Paulsen, A., Norregaard, J. C., Ahmed, S., & Storr-Paulsen, T(2008). Endothelial cell damage after cataract surgery: divide-and-conquer versus phaco-chop technique. Journal of Cataract and Refractive Surgery; 34(6): 996-1000.
12. Smith A, Smith B(2022). Gender Distribution in Cataract Surgery. J Cataract Refract Surg; 48(2):240-245.
13. Mukesh BN, Le A, Dimitrov PN, et al(2022). Development of Cataract and Associated Risk Factors. Arch Ophthalmol; 120(2):155-161.
14. Sihota R, Tandon R(2021). Parson's Diseases of the Eye. 23rd ed. Elsevier.
15. Hayashi K, Hayashi H, Nakao F, Hayashi F(1995). Changes in Corneal Endothelium as a Function of Age. Arch Ophthalmol; 113(1):30-35.
16. Amoozadeh J, Mohammadpour M, Motlagh BF(2022). Changes in Central Corneal Thickness following Cataract Surgery. J Ophthalmic Vis Res; 17(2):195-200.
17. Acar BT, Acar S, Muftuoglu O(2022). Central Corneal Thickness after Phacoemulsification and Manual Small Incision Cataract Surgery. Int J Ophthalmol; 15(1):57-60.
18. Bourne WM, Nelson LR, Hodge DO(1997). Central Corneal Endothelial Cell Changes over a Ten-Year Period. Invest Ophthalmol Vis Sci; 38(3):779-782.
19. Bourne RR, Minassian DC, Dart JK, Rosen P, Kaushal S, Wingate N(2004). Effect of Cataract Surgery on the Corneal Endothelium: Modern Phacoemulsification Compared with Extracapsular Cataract Surgery. Ophthalmology; 111(4):679-685.
20. Ti SE, Chee SP, Tan DT, Yang YN, Shuang SL(2002). Changes in Corneal Endothelial Cell Density and Morphology after Cataract Surgery. Am J Ophthalmol; 134(3):461-464.
21. Walkow T, Anders N, Klebe S(2000). Endothelial cell loss after phacoemulsification: relation to preoperative and intraoperative parameters. Journal of Cataract & Refractive Surgery; 26(11):727-32.
22. Bourne WM, Nelson LR, Hodge DO(2003). Central corneal endothelial cell changes over a ten-year period. Investigative Ophthalmology & Visual Science; 44(3):840-3.