Effect of Cataract Surgery on Graft Survival After Penetrating Keratoplasty

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ABSTRACT

Objectives: To evaluate the indications, complications, visual outcomes, and graft survival in eyes treated for cataracts developing after penetrating keratoplasty (PK).

Materials and Methods: This study involved a retrospective file review of patients who underwent keratoplasty followed by uncomplicated cataract surgery between January 2019 and October 2023. Patients were followed up postoperatively, with a maximum follow-up period of 26 months.

Results: A total of 22 eyes from 22 patients were included in the study. The average age of the patients was 63 years. The mean overall follow-up period was 14 months. The indications for PK were: keratoconus in 11 patients (50%), infectious keratitis in 6 patients (27%), traumatic scar in 3 patients (13%), and corneal dystrophy in 2 patients (10%). Graft failure occurred in 2 patients after cataract surgery, while the graft remained transparent in 20 patients (90.9%). Age, gender, and the indications for surgery had no statistically significant effect on the PK outcomes (P> 0.05).

Conclusion: This study demonstrates that cataract surgery following PK is successful in terms of visual rehabilitation and graft survival.

Keywords: Penetrating keratoplasty, cataract extraction, graft survival

INTRODUCTION

Cataract formation is more common in patients with corneal pathology and those who have undergone corneal transplantation[1-2]. There are various reasons for postoperative cataract development, such as the acceleration of pre-existing cataracts, steroid-induced cataract formation, or corneal graft rejection[3-4]. Cataract surgery in eyes that have undergone penetrating keratoplasty (PK) requires special attention and differs from routine surgical protocols. In addition to the standard risks of cataract extraction, the risk of graft failure in eyes with keratoplasty must also be considered. Studies have shown that the number of endothelial cells decreases over the years following PK[5-6]. Moreover, it is important to recognize that cataract surgery after keratoplasty may negatively impact graft longevity.

In the past, combined penetrating keratoplasty, extracapsular lens extraction, and intraocular lens implantation were performed in patients with cataracts and corneal pathology[7]. However, the practice of “open sky” surgery has mostly been abandoned due to potential risks such as posterior capsule rupture, expulsive hemorrhage, complications preventing intraocular lens placement, and challenges in achieving desired postoperative visual results. With advancements in phacoemulsification techniques and viscoelastics, penetrating keratoplasty now allows for endothelium-preserving surgery and improved

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postoperative visual outcomes close to emmetropia[2,7]. Additionally, more reliable intraocular lens (IOL) measurement evaluation and astigmatism adjustments have positively impacted postoperative visual outcomes compared to combined surgery.

In our study, we conducted a retrospective analysis of 22 eyes from 22 patients who had undergone cataract extraction following penetrating keratoplasty. Our evaluation focused on the corneal graft status, vision outcomes, and refractive errors both before and after the cataract extraction procedure.

MATERIAL AND METHODS

The study conducted a retrospective file review of patients who had undergone keratoplasty surgery between January 2019 and October 2023, followed by uncomplicated cataract surgery. Ethics committee approval was obtained, and informed consent forms were obtained from the patients before surgery. (29.03.2024/ B.30.2.ATA.0.01.00/175) The study included 22 eyes of 22 patients, all of whom had a graft diameter of 7.75 mm following PK surgery. Additionally, the corneal sutures were removed from these patients in preparation for subsequent cataract surgery. Following the keratoplasty surgery, all patients underwent phacoemulsification and IOL implantation. Their medical records and medical histories were collected, and various assessments were conducted, including vision level (VL) as per the standard Snellen chart, intraocular pressure (IOP) measurement using applanation tonometry, slit lamp biomicroscopy, fundus examination after pupil dilation, A-scan ultrasound for axial length measurements, and keratometric measurements using topography. Corneal endothelial cell count was performed before cataract surgery (Tomey Specular Microscope EM-4000). Preoperative assessments included evaluating the status of the corneal graft, anterior chamber, iris, pupil shape, and cataract degrees. The SRK/T formula was used with the Zeiss IOL Master 700 device to calculate the IOL power, with spherical correction as the target. Mean IOL power was 17.27 D.

While optical biometries typically provide reliable results for IOL measurements, they may not be effective in obtaining axial length measurements for hardened cataracts. In such cases, contact biometries can be used cautiously to avoid the risk of infection secondary to trauma in the graft. It is important to note that surgical time may be prolonged in hard cataracts and this could increase the risk of corneal endothelial damage. Therefore, selecting a viscoelastic with high endothelium protection is crucial to reduce the risk of rekeratoplasty.

Before cataract surgery, pupil dilation was achieved by instilling cyclopentolate-phenylephrine drops into the patients' eyes every 5 minutes. Cataract surgery was performed under local anesthesia (subtenon lidocaine). During the surgery, attention should be paid to high anterior chamber pressure, especially in cases where stitches have been removed. The main corneal incision was made along the steepest meridian to reduce astigmatism. Side-port incisions were made at the 3 and 9 o'clock positions. Viscoelastic material (Crownvisc 3%) was administered to protect the endothelium. After creating an approximately 6 mm wide capsulorhexis, the lens was removed using phacoemulsification. A foldable IOL was then placed into the capsular bag. If there was leakage at the wound site, the operation was terminated by placing 10/0 nylon sutures on the wound site. Postoperatively, topical ofloxacin and dexamethasone drops were administered 5 times a day. These medications were used for 1 month and then discontinued.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to calculate the mean ± standard deviation (SD) for numerical variables such as age. The Chi-square test was used for categorical data, while analysis of variance (ANOVA) was applied for continuous variables. Graft survival was analyzed using Kaplan-Meier survival analysis. Nominal P values were reported for all comparisons, with statistical significance defined as $P \leq 0.05$.

RESULTS

22 eyes of 22 patients were included in the study. Of the 22 patients, 12 were women and 10 were men. The average age was 63 years, with an age range of 55 to 76 years. The average time from PK to cataract extraction was 2.2 years, ranging from 6 months to 3 years. The effect of the time between PK and cataract surgery on surgical outcomes

could not be evaluated. The mean overall follow-up period was 14 months, with a maximum follow-up of 26 months. The indications for penetrating keratoplasty are shown in Table 1.

Table-1. *Penetrating Keratoplasty Indications*	
Indications	
Keratokonus	11(%50)
Infectius Keratitis	6(%27)
Traumatic scar	3(%13)
Corneal Dystrophy	2(%10)

A visual level (VL) of ≤ 1/10 accounted for 100% of the 22 eyes included in the study. The patients' preoperative vision levels were 2 ± 1.6 CF (counting fingers). The preoperative visual acuity is shown in Table 2. Preoperative IOP was normal, with an average of 14.12 ± 1.8 mmHg, measured using applanation tonometry. The highest average keratometric value was 42.34 D, and the lowest was 30.52 D. The mean preoperative astigmatism was 3.44 ± 3.12 D, and the mean spherical equivalent was 5.50 ± 2.34 D (Table 3).

Posterior subcapsular opacification was observed in the lenses of 13 patients (59.09%) and nuclear sclerosis in 9 patients (40.91%). All data regarding postoperative VL are shown in Table 4. It was observed that VL gradually improved, reaching the best levels after 6 months, with 81.8% of cases achieving a VL of ≥ 1/10.

When graft transparency was monitored after cataract surgery, corneal edema was observed in 3 patients during the first month. While the edema resolved in one patient, graft failure developed in 2 patients by the 6th month. Both of these cases involved patients who had undergone PK due to keratitis. The surgical outcomes for patients with keratoconus were particularly satisfactory in terms of vision improvement. Data regarding graft conditions are shown in Table 5.

When the endothelial cell count of the corneal graft was evaluated, it was 1584 ± 18 cells/mm² preoperatively, and 1521 ± 10 cells/mm² at the 6-month postoperative check. A graft sample before and after cataract surgery is shown in Figure 1. In 2 patients, the endothelial cell count could not be measured at the 6-month postoperative follow-up (Table 6).

Table-2. *Preoperative VL levels*			
Preoperative Vision			
Vision level(VL)	≤3 counting fingers from meter (mps)	3 mps-1/10	≥1/10
Eye	17	5	0

Table-3. *Preoperative and postoperative Refractive Errors*		
	Mean Preoperative Refraction	**Average Postoperative Refraction**
Spherical	5.50±2.34 D	2.2±1.4 D
Cylindrical	3.44±3.12 D	2.6±1.8 D

Table-4. *Postoperative VL levels*				
Postoperative Vision				
Vision Level(VL)	≤3 counting fingers from meter (mps)	3 mps-1/10	≥1/10	Total
Postop 1. month	3	11	8	22
Postop 3. month	2	5	15	22
Postop 6. month	2	2	18	22

Table-5. *Corneal Graft Health.*			
Corneal Graft Health			
Duration	Postop 1.month	Postop 3.month	Postop 6.month
Corneal Transparency	19	20	20
Edema	3	2	2
Graft rejection	0	0	2
Keratitis	0	0	0

Table-6. *Change in the number of graft endothelium.*		
Number of endothelium (mm²)	**Number of patients**	**Number of cells**
Preop	22	1584±18
1.month	19	1545±23
3.month	20	1531±16
6.month	20	1521±10

DISCUSSION

Although cataract is a disease that typically causes vision loss in older individuals, it can also occur after keratoplasty. In addition to the standard risks of cataract extraction, there is an increased risk of graft failure in patients who have undergone keratoplasty.

In a study by Rathi et al. on 184 eyes that underwent penetrating keratoplasty (PK), it was observed that 45 patients (24.45%) developed cataracts after several years. Notably, they reported that 31 of the 45 eyes developed cataracts within the first year after corneal transplantation[3]. Therefore, monitoring the development of cataracts in patients who have undergone keratoplasty and performing surgery when necessary is crucial to ensure visual recovery.

Final VL is an important criterion for evaluating cataract surgery outcomes. In our preoperative evaluation, VL was ≤ 3 CF (counting fingers) in 17 of 22 eyes (77.2%), with 11 of those eyes having a vision level of only hand movements, indicating severe vision loss. These data demonstrated that all patients had very poor vision before cataract surgery. After cataract surgery, 81.8% of the patients achieved a VL of ≥ 1/10 (highest 9/10, lowest 1/10). While penetrating keratoplasty followed by cataract extraction improved spherical refraction, cylindrical refraction remained relatively stable. This is an expected finding, likely due to the presence of the corneal graft.

Nagra et al., in their study, reported that graft health was preserved in 28 out of 29 patients (97%)[8]. Similarly, Hiep et al. reported graft transparency in 17 of 19 patients (89.47%)[9]. In our study, the corneal graft remained clear in 19 eyes (86.3%), while graft edema was observed in 3 eyes (13.7%). Among these 3 patients, the endothelial cell count was below 400 in 2 patients, and one patient had a dense, total cataract. After surgery, the edema in the patient with a hard cataract regressed, but graft failure occurred in the two patients with low endothelial cell counts. Graft transparency was preserved in 90.9% of the patients.

Controlling postoperative intraocular inflammation after corneal transplantation is crucial to preserving the clarity of the graft and preparing adequately for subsequent cataract surgery. Phacoemulsification cataract surgery with IOL implantation was successfully performed without complications in all our patients. Posterior capsule opacification developed in 4 patients, and YAG laser capsulotomy was performed for these patients.

The study had several limitations. In particular, the time elapsed after keratoplasty, diagnostic differences before keratoplasty, cataract type, and surgery duration varied among patients. The small sample size and relatively short average follow-up period also limit the study. Despite these limitations, we conclude that cataract extraction after penetrating keratoplasty is a satisfactory procedure.

There appears to be a low risk of graft failure following cataract extraction, with patients benefiting from increased visual acuity and improvement in refractive errors. Additionally, performing cataract surgery after PK, rather than combining PK and cataract surgery, may offer better control of postoperative refractive errors.

The success rate of phacoemulsification cataract surgery after PK is notable, and the survival rate of the final graft was good. However, longer-term follow-up of patients is necessary to thoroughly evaluate graft health. The small number of patients and the relatively short average follow-up period remain limitations of the study.

CONCLUSION

Cataract development after keratoplasty is a frequently encountered situation in clinical practice. With current cataract surgery, graft health and visual rehabilitation can be successfully achieved.

Patient consent: Informed consent forms were obtained from the patients before surgery.

Conflict of interest: There is no conflict of interest between the authors.

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