ARTICLE

Cataract surgery after deep anterior lamellar keratoplasty and penetrating keratoplasty in age- and disease-matched eyes

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Purpose: To assess the efficacy and safety of cataract surgery after deep anterior lamellar keratoplasty (DALK) and penetrating keratoplasty (PKP).

Setting: Tokyo Dental College Ichikawa General Hospital, Chiba, Japan.

Design: Retrospective case series.

Methods: Age-matched and disease-matched eyes that had phacoemulsification and intraocular lens insertion after DALK or PKP were studied. Graft clarity was assessed at the final follow-up. The difference in the endothelial cell density (ECD), corrected distance visual acuity (CDVA), spherical equivalence, and refractive error between the expected values and values 1, 3, 6, and 12 months after cataract surgery were compared between the 2 groups.

Results: Indications for keratoplasty were corneal stromal scar (22 eyes), lattice dystrophy (2 eyes), keratoconus (2 eyes), and postherpetic keratitis (4 eyes). All 30 eyes in each group had successful cataract surgery after keratoplasty. Graft clarity rates were 90.0% and 80.0% in the DALK group and PKP group, respectively ($P = .47$). The decrease in ECD at 12 months was significantly greater in the PKP group than in the DALK group (8.7% [SD] $\pm$ 21.7% versus 26.3% $\pm$ 27.8%) ($P = .043$). The CDVA was significantly improved in both groups. At 1 month, the mean refractive error was −0.5 diopter (D) $\pm$ 2.4 (SD) in the DALK and −0.4 $\pm$ 1.9 D in the PKP groups and remained stable thereafter.

Conclusions: Cataract surgery was successfully performed in eyes that had DALK or PKP, providing excellent visual and refractive outcomes. In cases of combined cataract and corneal pathology, and in the absence of endothelial involvement, DALK followed by cataract surgery might cause less endothelial damage.

J Cataract Refract Surg 2018; ■:■–■ © 2018 ASCRS and ESCRS

The development of component lamellar surgery has markedly changed the transplantation strategy for pathologic corneas.[1–3] Deep anterior lamellar keratoplasty (DALK) is suitable for corneal lesions lacking endothelial involvement, including in cases of keratoconus, corneal stromal dystrophy, and corneal stromal scarring, and has been recognized as an alternative to penetrating keratoplasty (PKP).[4] Recent developments in the facilitation and sophistication of surgical techniques have contributed to an increasing number of DALK cases.

A corneal lesion accompanied by a cataract is a common entity in older patients. In the pre-DALK era, PKP combined with extracapsular cataract extraction (a triple procedure) and phacoemulsification after PKP (a 2-step procedure) has been adopted for corneal lesions and cataracts, even when no endothelial damage was present. Compared with the 2-step procedure, the triple procedure has various complications, including expulsive hemorrhage, intraocular lens (IOL) insertion failure caused by posterior capsule rupture,[5] and refractive error. Some studies[6,7] have shown advantages of the secondary approach.

As DALK has become more widely available, cases requiring cataract surgery after DALK have increased. Unlike PKP, cataract surgery after DALK has not been fully investigated. Phacoemulsification after DALK has the potential advantage of being a 2-step procedure and could also result in less endothelial immunological rejection

Submitted: August 24, 2017 | Final revision submitted: January 3, 2018 | Accepted: January 3, 2018

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0886-3350/$ - see frontmatter
https://doi.org/10.1016/j.jcrs.2018.01.024

Table 1. Patients' profile.

Group	Age (Y)		Male/Female (n)	Lattice Dystrophy	
	Mean ± SD	Range		<70 Y	≥70 Y
DALK (n = 30)	68.0 ± 8.4	50, 85	13:17	2	0
PKP (n = 30)	69.4 ± 8.3	51, 85	12:18	2	0
P value	.5		1.0	—	

DALK = deep anterior lamellar keratoplasty; PKP = penetrating keratoplasty

caused by intraocular surgery than phacoemulsification after PKP. However, the impact of intraocular maneuvering on the host Descemet membrane is unclear. Interface opacity between the host's Descemet membrane and the graft stromal bed is another concern in terms of whether cataract surgery will be successful. In addition, the amount of postoperative endothelial cell loss and refractive error remain unclear.

Therefore, to evaluate the efficacy and safety of cataract surgery after DALK and to compare these results with those after PKP, we have performed an age-matched and disease-matched case-control study.

PATIENTS AND METHODS

This retrospective study was performed in accordance with the tenets of the Declaration of Helsinki. It was approved by the Institutional Ethics Review Board, Tokyo Dental College, Ichikawa General Hospital, Chiba, Japan. The Institutional Review Board waived the requirement for obtaining informed consent for this retrospective study. Patient data were anonymized before access and/or analysis.

Patients

This study evaluated consecutive age-matched and disease-matched patients from a cohort who had cataract surgery after DALK or PKP at the Department of Ophthalmology, Tokyo Dental College (TDC), Ichikawa General Hospital, between January 2001 and December 2014. The included patients were selected on the basis of the following inclusion criteria: (1) indications for keratoplasty were corneal lesions without endothelial involvement, including corneal stromal scar post-interstitial keratitis, post-herpetic corneal opacity, corneal lattice dystrophy, and keratoconus; (2) follow-up longer than 3 months; and (3) first-time keratoplasty performed at TDC Ichikawa General Hospital. Patients were excluded if they had regrafts, had congenital amblyopia, or lacked a central visual field because conditions such as glaucoma and traumatic optic neuropathy. In addition, the study included no patient who had previous astigmatic surgery, such as astigmatic keratotomy or compression sutures, before cataract surgery.

The patients in the post-herpetic keratitis group had no history of uveitis or central macular edema. A systemic antiviral agent was given for approximately 3 weeks after keratoplasty to prevent recurrence of herpetic keratitis in these patients. All patients received an explanation of DALK or PKP. After, a decision was made on which procedure. This depended on the patient's choice, the patient's general condition, or both. The evaluation of each patient's condition included a determination of whether he or she could maintain the supine position if an air injection was required after DALK.

Surgical Technique

Keratoplasty Retrobulbar anesthesia by an injection of lidocaine 2.0% plus epinephrine was given in all cases. In PKP, the donor corneas were prepared with a Barron donor punch (Katena Products, Inc.) with a diameter 0.25 to 0.50 mm greater than the recipient bed. Recipient corneas were trephined using a Hessburg–Barron trephine (Katena Products, Inc.).

In DALK, full-thickness stromal removal[8] was performed using the layer-by-layer technique,[9] the big bubble or double-bubble technique,[10,11] or the Melles light reflex technique[12–14] after trephination of the recipient's stroma using a Hessburg-Barron trephine. When microperforation of Descemet membrane occurred, room air was injected into the anterior chamber at the end of surgery. Donor corneas were prepared with a Barron donor punch that was 0.25 mm larger than the recipient bed, and the endothelium and Descemet membrane were stripped off using a toothed forceps.

In both groups, single continuous 10-0 nylon was secured followed by suture adjustment to minimize postoperative

Table 2. Outcomes of cataract surgery by keratoplasty group.

Group	Time from Keratoplasty to Cataract Surgery (Mo)		Mean Preop Cataract Grade (1–4) ± SD	IOL Insertion
	Mean ± SD	Range		
DALK	14.8 ± 14.4	3.0, 71.5	2.4 ± 0.7	30
PKP	14.9 ± 9.9	2.7, 43.9	2.5 ± 0.8	29
I value	1.0		0.5	—

DALK = deep anterior lamellar keratoplasty; IOL = intraocular lens; PCR = posterior capsule rupture; PKP = penetrating keratoplasty