

## “Mouse Sign” on Optical Coherence Tomography of Detached Endothelial Graft Indicates Graft Inversion

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### Abstract

**Purpose:** To report the mouse-like configuration of detached endothelial keratoplasty graft observed on optical coherence tomographic imaging after pre-Descemet's endothelial keratoplasty (PDEK).

**Case Report:** Three eyes of 3 patients who underwent PDEK and had graft detachment in the initial postoperative period of <2 weeks were examined. Fourier domain optical coherence tomography was performed in all eyes. All 3 patients had partial graft detachment with the detached region involving the central and inferior cornea. One end of the graft formed a thick convex scroll detaching outward, downward, and upward, and the other end was attached to the edematous cornea forming the 'mouse' configuration. The graft was inverted, and rebubbling failed in all 3 eyes. Graft exchange was required.

**Conclusion:** Mouse sign in OCT imaging indicates the possibility of an inverted graft and predicts unsuccessful rebubbling. Graft exchange is required in such eyes.

**Keywords:** Graft Detachment; Mouse Configuration in Endothelial Graft; Mouse Sign in OCT; Mouse Sign in PDEK; Mouse Sign; OCT Configuration of Inverted Graft; Pre-Descemet's Endothelial Keratoplasty

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### INTRODUCTION

Endothelial keratoplasty is the accepted technique of choice for treating corneal endothelial diseases.<sup>[1-4]</sup> Re-endothelialization may be associated with massive endothelial migration and some form of cell signaling to draw donor endothelial cells toward the recipient posterior stroma.<sup>[4]</sup> The most common complication following endothelial keratoplasty is graft detachment.<sup>[4,5]</sup>

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Intrinsic properties of the host and multiple factors in the graft play a role in graft adherence.<sup>[4-7]</sup> Anterior segment optical coherence tomography has been used for detection and quantification of graft detachments which are often observed as a displaced layer of the graft away from the stroma.<sup>[3,8,9]</sup> Herein, we report a unique configuration of endothelial keratoplasty grafts mimicking a computer mouse in patients with tight scrolls, which often were difficult to unroll and required graft removal.

### CASE REPORT

This is a short case series of three patients who underwent pre-Descemet's endothelial keratoplasty (PDEK) for corneal endothelial decompensation. The patients underwent Fourier domain optical coherence

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tomographic (OCT) analysis (Cirrus 5000, Carl Zeiss Meditec) of the graft after the surgery. The patients’ details and OCT images were assessed. The study was approved by an institutional review board, and informed consent was obtained from the patients in this study. The data were tabulated, and a literature search on similar presentations was performed.

### Case Presentations

Thirty-two eyes underwent the procedure during the period in which we noted the unique OCT configuration of graft detachment. Out of 32 eyes, 5 (15.6%) developed graft non-attachment after surgery. Three of the 5 cases showed a unique ‘mouse’ configuration. Two eyes without graft attachment that did not exhibit the configuration underwent successful rebubbling, whereas rebubbling was unsuccessful in 3 eyes with ‘mouse’ configuration.

#### Patient 1

A 60-year-old woman presented with blurred vision, redness, pain, and watering of the right eye after cataract extraction and intraocular lens (IOL) implantation that was performed 2 months back. Examination revealed the best-corrected visual acuity (BCVA) (OD) of 20/1200 and 20/80 (OS). Slit lamp examination revealed pseudophakic bullous keratopathy (PBK) (OD) and nuclear sclerosis grade II (OS). The patient underwent PDEK [Table 1]. In the immediate postoperative period, the graft showed adherence with mild corneal edema. Examination on the 10<sup>th</sup> postoperative day (POD) revealed diffuse stromal edema, Descemet’s folds, and rolled graft detachment centrally. Results of examination using Fourier domain optical coherence tomography (FDOCT) showed a partially detached graft involving the central and inferior parts of the grafts with the convex configuration [Figure 1], and one end was still attached to the recipient cornea. The graft configuration was similar to a “computer mouse.” The patient underwent rebubbling on the same day. A follow-up examination 3 days later revealed an epithelial defect,

stromal edema, and the same convex detached graft. Subsequently, graft exchange was performed.

#### Patient 2

A 64-year-old woman presented with blurred vision, redness, pain, and watering of the left eye for 3 months. She had a history of cataract extraction and IOL implantation in the same eye 2 years ago. Examination revealed the BCVA (OD) of 20/40 and finger counting close to face (OS). Slit lamp examination showed pseudophakia in both eyes with PBK with anterior chamber (AC) IOL in left eye. The patient underwent AC IOL explantation with glued IOL fixation, pupiloplasty, and PDEK in the left eye [Table 1]. Examination on POD 1 revealed diffuse stromal edema, graft detachment involving the central and inferior cornea, stable IOL, and formed pupil. Results of the examination using the FDOCT showed the convex detached graft scrolled in one end, while the other end attached to the recipient cornea [Figure 2]. The patient underwent rebubbling on POD 2 in an attempt to re-attach the graft. Follow-up examination 2 days later showed stromal edema and a detached rolled graft in the same mouse configuration. The patient underwent air injection again, but the graft continued to roll and detach the next day. The patient underwent graft exchange later.

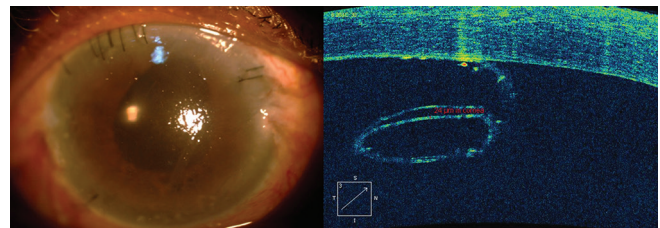
#### Patient 3

A 59-year-old man with a history of phacoemulsification and IOL implantation in the right eye 2 years previously presented with a complaint of blurred vision for 2 months. Examination revealed the BCVA of 20/200 (OD) and 20/30 (OS). Slit-lamp examination revealed corneal decompensation with PBK in the right eye, and PDEK surgery was performed [Table 1]. Examination on POD 2 revealed diffuse stromal edema and graft detachment centrally and inferiorly. Results of an examination using the FDOCT showed detached, inverted, convex graft in the anterior chamber [Figure 3]. The patient underwent rebubbling with air on POD 2 in an attempt to re-attach the graft. Follow-up examination on POD 8 revealed an epithelial defect, stromal edema, detached graft, and the

**Table 1. Demographic parameters of 3 patients**

Parameters	Patient 1	Patient 2	Patient 3
Recipient age	60 yrs	64 yrs	59 yrs
Initial surgery for PBK	PDEK	PDEK	PDEK
Donor age	32 yrs	19 yrs	47 yrs
PDEK graft size	7.5 mm	7 mm	7 mm
Graft thickness	24 µm	36 µm	48 µm
Postoperative day of detachment	10	1	2
Rebubbling attempts	1	2	2

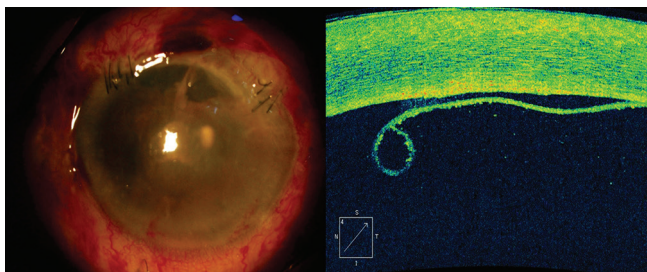
PDEK, pre-Descemet’s endothelial keratoplasty; PBK, pseudophakic bullous keratopathy; yrs, years



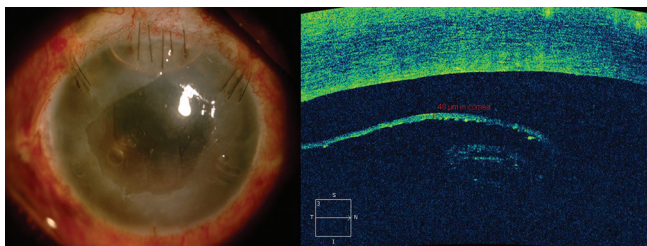
**Figure 1.** (Left) Postoperative clinical photograph after initial PDEK showing the centrally detached graft and (right) the corresponding FDOCT showing convex graft rolled in one end, and inverted, and one end attached to the cornea showing the “mouse configuration”.

reversed convex graft in the mouse configuration. The patient underwent rebubbling again, which failed to reattach the graft; hence, graft exchange was performed later.

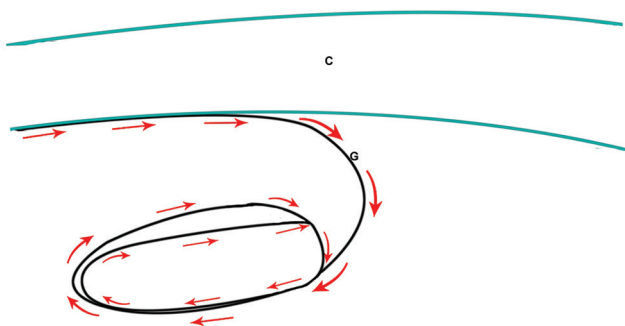
All 3 patients had graft detachment of <2 weeks. Corneal edema was present on day one in the all 3 eyes. The age of the donor ranged from 19 to 47 years (mean ± SD, 32.6 ± 14 years). The mean graft diameter was 7.1 ± 0.3 mm, and the mean graft thickness was 36 ± 12 µm. The endothelial graft was detached in the central and inferior cornea with the graft detaching in the outward and downward direction, and then in an upward direction, forming a thick convex scroll on one end, whereas the other end of the graft remained attached to the recipient cornea [Figure 4]. This



**Figure 2.** (Left) Postoperative clinical photograph after initial PDEK showing inferotemporal and central detachment and (right) the corresponding FDOCT showing convex graft rolled in one end in a “mouse configuration” and attached to the cornea.



**Figure 3.** (Left) Postoperative clinical photograph after initial PDEK and (right) the corresponding FDOCT showing convex graft rolled central and inferior and inverted in a “mouse configuration”.



**Figure 4.** Illustration showing the formation of the “mouse configuration.” C: Cornea G: Graft.

appearance resembled a computer mouse (i.e scrolled part as the mouse, and the attaching or hanging graft as the connecting wire). Two out of 3 eyes had 2 attempts of rebubbling. Rebubbling failed in all eyes [Table 1], and reinversion attempts were unsuccessful. All eyes required graft exchange.

## DISCUSSION

Factors favoring the attachment of a graft to the host cornea include a stable, well-formed anterior chamber morphology and chamber pressure, which is achieved by adequate air filling to about 80% of the anterior chamber volume.<sup>[4-7]</sup> Higher donor age (which is associated with easy unrolling of the graft) and postoperative supine position have also been known as factors favoring adherence.<sup>[6,7]</sup> Factors favoring graft displacement are incomplete host endothelial and Descemet’s membrane removal and residual anterior band layer fragments.<sup>[7]</sup> *In situ* glaucoma drainage devices, post trabeculectomy blebs, and post vitrectomy status are the additional factors which are associated with graft detachments.<sup>[10,11]</sup>

Graft reversal is identified when the endothelial side of the donor graft faces the recipient cornea while the Descemet’s membrane faces the iris-lens diaphragm. There are many techniques suggested to identify and avoid graft reversal intraoperatively. Bimanual infusion technique, endoilluminator-assisted endothelial keratoplasty, F mark, S mark, intraoperative OCT, triangular mark, Taco configuration, Venn diagram, and Mourtiser’s sign are the clinical methods used to identify the orientation of the endothelial graft intraoperatively.<sup>[12-17]</sup> Dirisamer et al studied a series of graft displacements and grouped them into various presentations; they noted that the upside down graft showed reverse corneal clearance and interface spikes.<sup>[18]</sup> They also observed that 11% of the graft detachments were due to invert grafting.

The three cases that we encountered had a partially rolled graft detachment involving >1/3 of the surface area. The corneal edema did not clear despite the observation and air bubbling. All 3 eyes developed graft detachment and non-resolving corneal edema in <2 weeks after surgery, indicating that immediate factors were responsible for these observations. The configuration of the “mouse” was seen in all patients with thick scrolls that were difficult to unrolling. Graft detachment recurred in the same configuration after a repeat of air injection. The observed pattern was similar in all 3 patients, with partial attachment in one end and a movement outward, downward, upward, and then inward to form the configuration [Figure 4]. The probable reasons that have been reported for the rolling of the grafts are (1) the uncorrected rolled or curled edges at the end of surgery (2) insufficient air support inside the chamber (3) inverse graft positioning (4)

stromal irregularities or incomplete recipient DM removal. Graft edema, tendency to form tight scroll, and premature loss of air support are the probable reasons for this configuration in our patients. Although the influence of donor age on the graft configuration cannot be ruled out, the age in our series ranged from 19 years to 47 years, which included both young and middle-aged eyes. The rebubbling attempts failed in all cases because the graft regained the same configuration each time after manipulation. Although elderly donors have been shown to have easy intraoperative unrolling during Descemet’s membrane endothelial keratoplasty, young people have also been shown to have favorable graft adherence after PDEK.<sup>[9,3]</sup> We did not use long-acting intracameral gas for graft adhesion because there have been reports of IOL opacification. Although anterior segment OCT has been used to evaluate and confirm intraoperative positioning and postoperative attachment status in DMEK and PDEK, there are no reports showing similar graft configuration postoperatively that required graft exchange or graft removal after repeated rebubbling. Therefore, we feel this sign on OCT imaging should alarm the surgeon about the possibility of failure of reattachment by air injection due to inversion and the need for graft exchange. Proper intraoperative endothelial side orientation techniques such as intraoperative use of OCT or S stamp sign can reduce the incidence of graft detachment.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of Interest

There are no conflicts of interest.

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