American Journal of Ophthalmology Case Reports 11 (2018) 13–16

Contents lists available at ScienceDirect

American Journal of Ophthalmology Case Reports

journal homepage: www.elsevier.com/locate/ajoc

Case report

Rescue technique for a partially expulsed descemet membrane endothelial keratoplasty (DMEK) graft

Michele D. Lee, Lisa Y. Chen, Charles C. Lin*

Byers Eye Institute, Stanford University School of Medicine, Palo Alto, CA, USA

ARTICLE INFO

Keywords:
DMEK
Expulsed graft
Rescue technique

ABSTRACT

Purpose: To describe a novel surgical technique to rescue a partially expulsed DMEK graft after insertion.
Observations: We present a case of a 66-year-old woman with visually significant Fuchs endothelial dystrophy who underwent a DMEK surgery complicated by partial expulsion of the DMEK graft during insertion. To rescue the graft, MicroSurgical Technology (MST) forceps were inserted through a nasal paracentesis to grasp the DMEK graft and redirect it back into the anterior chamber. The surgical technique and postoperative outcomes are described. The partially expulsed graft was centered and attached successfully during surgery. Postoperatively, the patient required two rebubbling procedures, but achieved best-corrected visual acuity of 20/20 vision 1 month after surgery.
Conclusions: and Importance: We describe an underreported complication and present a novel rescue technique for a partially expulsed DMEK graft that is effective and minimizes manipulation of the graft.

1. Introduction

Endothelial keratoplasty (EK) surgery, in particular Descemet Stripping Automated Endothelial Keratoplasty (DSAEK), has replaced full-thickness penetrating keratoplasty as the procedure of choice for endothelial decompensation due to predictable refractive outcome, faster visual recovery, and standardization of donor graft preparation.[1,2] Recently, Descemet membrane endothelial keratoplasty (DMEK) has gained momentum due to even superior visual acuity, quicker visual recovery, and lower rates of corneal graft rejection.[3–5]

However, DMEK surgery is still not as commonly performed as DSAEK due to the technical difficulty of the surgery and increased intraoperative and postoperative complications, such as graft inversion, tissue damage during preparation or surgery, and graft detachment.[6,7] Direct manipulation of the 10 μm graft, consisting of Descemet's membrane and endothelial cells, should be minimized to avoid endothelial cell loss and maximize visual recovery.[8] The fragility of the graft, reliance on fluid mechanics, and lack of rescue techniques pose challenges when graft deployment does not proceed smoothly.

Herein, we describe a DMEK surgery complicated by partial expulsion of the graft and subsequent rescue. To our knowledge, there have been no prior reports of or described rescue techniques for an expulsed or partially expulsed DMEK graft.

2. Case report

The patient was a 66-year-old female who initially presented to our institution for cataract consultation. At the time, her best-corrected visual acuity in her left eye was 20/40, and she was noted to have moderate central guttae in both eyes, consistent with Fuch endothelial dystrophy. No endothelial cells were visualized on specular microscopy in both eyes.

She underwent a combined cataract and DMEK surgery in the left eye. The DMEK graft had an endothelial cell density of 3012 cells/mm^2. Death to preservation time was 4 hours and 56 minutes, and death to surgery time was 4 days. The graft was punched with an 8.0 mm Barron trephine and stained with Trypan blue prior to being loaded into the Straiko-Jones tube (Gunther Weiss Scientific Glassblowing Co, Portland, OR) for insertion into the eye through a temporal 3.2 mm incision.

During graft insertion, anterior chamber depth and intraocular pressure were modulated through the paracenteses using balanced salt solution on a 30-gauge cannula. However, the DMEK graft partially expulsed around the Straiko-Jones tube, with half of the graft wedged in the main wound while the other half remained in the anterior chamber (see Fig. 1 and Video 1). We describe our rescue approach below.

Supplementary video related to this article can be found at http://dx.doi.org/10.1016/j.ajoc.2018.04.015.

* Corresponding author. Byers Eye Institute, 2452 Watson Court, Palo Alto, CA 94303, USA.
E-mail address: lincc@stanford.edu (C.C. Lin).

https://doi.org/10.1016/j.ajoc.2018.04.015
Received 28 October 2017; Received in revised form 20 March 2018; Accepted 17 April 2018
Available online 21 April 2018

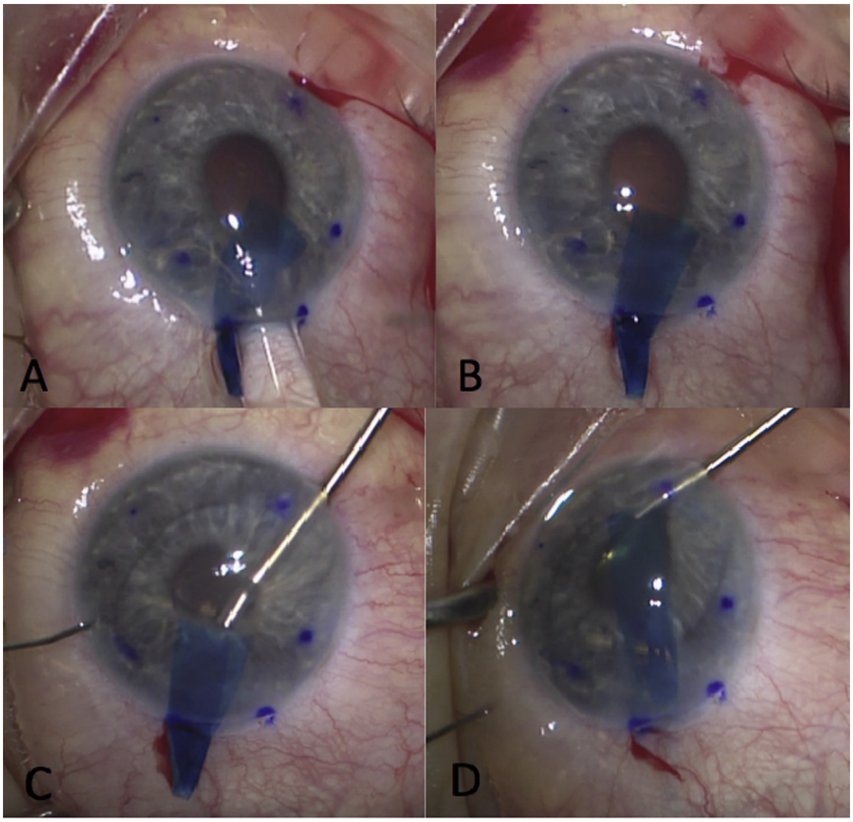

Fig. 1. Sequential images in our case of a partially expulsed Descemet membrane endothelial keratoplasty (DMEK) graft. A) The graft after partial expulsion through the main wound around the Straiko-Jones tube. B) The partially expulsed graft after careful removal of the Straiko-Jones tube. C) MicroSurgical Technology (MST) smooth tip forceps were inserted through the nasal paracentesis across the anterior chamber to carefully grasp the DMEK graft at its nasal edge. D) The DMEK graft was successfully redirected back into the anterior chamber.

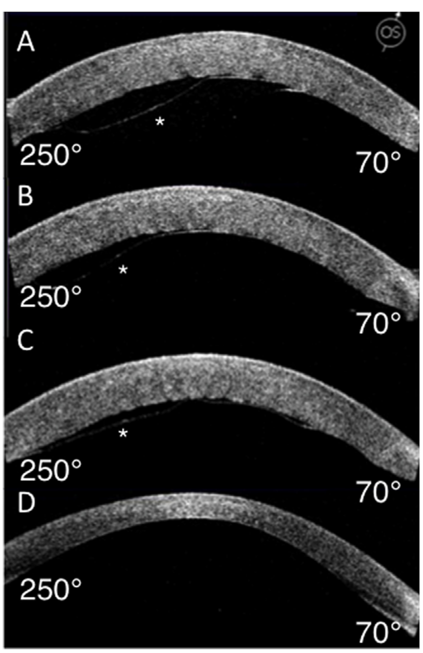

Fig. 2. Post-operative anterior segment optical coherence tomography images (Visante OCT, Carl Zeiss, Inc., Tarpon Springs, FL). A) Inferotemporal DMEK graft detachment at 250° at postoperative day 1 (asterisk). B) Persistent inferotemporal DMEK detachment (asterisk) at 250° at postoperative day 3, prior to first rebubble procedure. C) Persistent DMEK graft detachment at 250° (asterisk) at postoperative day 8 despite first rebubble procedure. D) Postoperative day 11 images showing full attachment of DMEK graft following second rebubble procedure.

3. Materials and methods

In order to rescue the partially expulsed graft, multiple maneuvers were attempted. The paracenteses were burped to further shallow the anterior chamber and lower intraocular pressure. With care to avoid directly touching the expulsed portion of the graft, the cornea was gently tapped and troked with a 30-gauge cannula to create small fluid waves in the anterior chamber in an attempt to move the graft centrally, which was unsuccessful. A pull-through attempt using aspiration was attempted by first enlarging an existing nasal paracentesis 180° away from the main wound. Without irrigation, an MST Duet aspiration cannula (Microsurgical Technology, Redmond, WA) was inserted through the nasal paracentesis across the anterior chamber and gentle aspiration applied to the leading edge of the DMEK graft in the eye to attempt to grasp the graft and pull it into the anterior chamber. However this did not provide enough suction power to successfully free the graft from the main wound.

As a final resort, MST smooth tip forceps were inserted through the nasal paracentesis across the anterior chamber to carefully grasp the DMEK graft at its nasal edge, and redirect it back into the anterior chamber (see Video 2). Simultaneous injection of small amounts of balanced salt solution (BSS) through separate paracenteses was performed as needed to maintain adequate anterior chamber depth. The wound was immediately sutured, the graft was unfolded and centered successfully, and 20% sulfur hexafluoride (SF_6) gas was injected into the anterior chamber.

Supplementary video related to this article can be found at http://dx.doi.org/10.1016/j.ajoc.2018.04.015.

4. Results

On postoperative day 1, the patient's vision was hand motion vision in the operative eye, and the graft was detached inferiorly and temporally. The patient required two rebubbling procedures with air to achieve full graft attachment (see Fig. 2). By post-operative month 1, the cornea was clear with best-corrected visual acuity of 20/20 and corneal pachymetry of 557 μm. At her post-operative month 6 appointment, the patient's best corrected visual acuity was 20/20, the corneal thickness was 573 microns, and specular microscopy revealed an endothelial cell density of 574 cells/mm^2. One year post-operatively, her best-corrected vision remained 20/20, corneal pachymetry was 568 μm, and the endothelial cell count was 618 cells/mm^2.

5. Discussion

In this case, we successfully rescued a DMEK graft that was partially expulsed from the main wound by using a novel pull-through technique with MST forceps. There are several options for rescuing an expulsed DMEK graft, each of which carries its own set of advantages and disadvantages. The DMEK graft can be completely removed from the anterior chamber with forceps, then reloaded and reinjected. However, this approach likely causes more endothelial cell damage as the entire graft will be subject to mechanical compression as it is pulled through the main wound as well as the focal compression force from the forceps. Moreover, if significant posterior pressure contributed to graft ejection in the first place, a second attempt will encounter the same challenge. To minimize inducing additional compression damage to the portion of the DMEK graft still within the anterior chamber, one can grasp the expulsed portion of the DMEK graft with forceps and reposit it through the main wound into the anterior chamber, similar to a forceps insertion technique for a DSAEK. Similarly, the expulsed portion of the DMEK graft can be reposited into the eye with a 27 or 30-gauge cannula. However, these maneuvers can also induce further damage to the graft due to excessive manipulation and risk complete expulsion of the graft when the wound is gaped.

Pull-through techniques using a carrier scaffold are used successfully among some DMEK surgeons[9,10] and have been demonstrated to induce minimal damage to the DMEK graft with a very low 9.9% endothelial cell loss.[9] In our case, we used a modified pull-through technique, theorizing that this rescue approach would mitigate additional surgical trauma to an already compromised graft by manipulating less of the graft. Pulling the graft into the anterior chamber via an aspiration cannula may be attempted, as was initially done in this case. However, the success of this approach may be limited by the ability to generate adequate suction force to manipulate the graft. Moreover, dry aspiration can quickly shallow the anterior chamber, causing further iatrogenic graft damage due to contact with the intraocular lens. If irrigation were used, there is risk of complete expulsion of the graft due to increased anterior chamber pressure.

By gently grasping the leading edge of the graft within the anterior chamber with MST forceps, as we describe in our technique here, the appropriate amount of force can be applied to manipulate the graft while still minimizing trauma. If care is taken to grasp an adequate amount of the graft so that tension is distributed evenly, the graft is robust enough to resist the shearing stress of the forceps without tearing during this rescue maneuver. In cases where the graft is only minimally incarcerated in the wound without protrusion out of the wound, a gentle “no-touch” technique in which a cannula is stroked over the main wound may be sufficient to nudge the graft fully into the AC.

Of course, it is best to prevent graft expulsion from occurring in the first place. One key to prevention is ensuring that the main wound is appropriately sized to prevent fluid egress during insertion. We recommend always testing the insertion tube in the wound prior to loading the graft to ensure a snug fit. This is particularly important when using the Straiko-Jones tube as each tube is individually hand-blown and variable in size. With its flared design, the Straiko-Jones tube can be wedged into the corneal wound, minimizing fluid egress and mitigating the risk of graft expulsion. During graft insertion, utmost attention should be paid to continuously modulating anterior chamber depth and pressure, keeping the anterior chamber shallow by frequent burping of the paracenteses. Injecting bursts of fluid to rotate the graft so that it is perpendicular to the wound as well as flattening the anterior chamber prior to removal of the insertion tube can also reduce the risk of graft ejection. Finally, during withdrawal of the injector device, simultaneous compression of the anterior lip of the wound can prevent graft migration into the wound.

In our patient, we encountered difficulty with injecting the DMEK graft into the anterior chamber as the trailing end of it remained in the Straiko Jones tube despite several attempts to completely inject it. This is a clue that additional bursts of fluid without sufficient anterior chamber decompression can lead to graft expulsion, as occurred in this case. This ultimately led to a significant 81% endothelial cell loss at 6 months, which is much higher than the reported range of 28%–41%.[11,12] Of course, considering the significant endothelial cell damage, one must balance short-term outcomes with the long-term viability of the graft. Fortunately, despite significant surgical trauma and substantial endothelial cell loss, the graft ultimately was able to recover, resulting in a clear cornea and excellent 20/20 visual acuity for our patient. Multiple rebubble attempts were required for the graft to fully attach. In these difficult cases with significant intraoperative manipulation, perseverance is required on the part of both the patient and the surgeon during the postoperative course. If the patient is motivated, we recommend multiple rebubble attempts before giving up on the graft. One year post-operative results for this patient were encouraging with excellent visual acuity and stable endothelial cell count.

As DMEK surgery becomes more commonly performed, there will be an increase in complications and a need for a “toolbox” of intraoperative maneuvers. In this report, we illustrate an underreported complication of DMEK surgery and describe a novel technique that can successfully rescue a partially expulsed DMEK graft resulting in excellent visual outcome.

Patient consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patient.

Acknowledgement and disclosures

Our institution is supported by the Research to Prevent Blindness and the National Institutes of Health Core grant, P30-EY026877. The following authors have no financial disclosures: MDL, LYC, CCL.

References

1. Melles GRJ. Posterior lamellar keratoplasty: DLEK to DSEK to DMEK. *Cornea.* 2006;25:879–881.
2. Gorovoy MS. Descemet-stripping automated endothelial keratoplasty. *Cornea.* 2006;25:886–889.
3. Guerra FP, Anshu A, Price MO, Price FW. Endothelial keratoplasty: fellow eyes comparison of Descemet stripping automated endothelial keratoplasty and Descemet membrane endothelial keratoplasty. *Cornea.* 2011;30:1382–1386.
4. Muftuoglu O, Prasher P, Bowman RW, et al. Corneal higher-order aberrations after Descemet's stripping automated endothelial keratoplasty. *Ophthalmology.* 2010;117:878–884.
5. Melles GR, Ong TS, Ververs B, et al. Descemet membrane endothelial keratoplasty (DMEK). *Cornea.* 2006;25:987–990.
6. Kruse FE, Laaser K, Cursiefen C, et al. A stepwise approach to donor preparation and insertion increases safety and outcome of Descemet membrane endothelial keratoplasty. *Cornea.* 2011;30:580–587.
7. Dapena I, Ham L, Droutsas K, et al. Learning curve in Descemet's membrane endothelial keratoplasty. *Ophthalmology.* 2011;118:2147–2154.
8. Dapena I, Moutsouris K, Troutsas K, Ham L, van Dijk K, Melles GR. Standardized “no-touch” technique for descemet membrane endothelial keratoplasty. *Arch Ophthalmol.* 2011;129:88–94.
9. Busin M, Leon P, Scorcia V, Ponzin D. Contact lens-assisted pull-through technique for delivery of tri-folded (endothelium in) DMEK grafts minimizes surgical time and cell loss. *Ophthalmology.* 2016;123:476–483.
10. Ang M, Mehta JS, Newman SD, Han SB, Chai J, Tan D. Descemet membrane endothelial keratoplasty: preliminary results of a donor insertion pull-through

technique using a donor mat device. *Am J Ophthalmol.* 2016;171:23–34.
11. Hamzaoglu EC, Straiko MD, Mayko ZM, Sales CS, Terry MA. The first 100 eyes of standardized descemet stripping automated endothelial keratoplasty versus standardized descemet membrane endothelial keratoplasty. *Ophthalmology.* 2015;122:2193–2199.
12. Tourtas T, Laaser K, Bachmann BO, Curseifen C, Kruse FE. Descemet membrane endothelial keratoplasty versus descemet stripping automated endothelial keratoplasty. *Am J Ophthalmol.* 2012;153:1082–1090.