



Treatment of Descemet's membrane detachment after primary Descemet's stripping automated endothelial keratoplasty during surgery using intraoperative optical coherence tomography

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ABSTRACT

Purpose: To present a novel microscope-integrated optical coherence tomography (iOCT)-guided surgical technique wherein Descemet's membrane detachment (DMD), occurring during vitrectomy, was treated intraoperatively in a patient who had previously undergone Descemet's stripping automated endothelial keratoplasty (DSAEK).

Observations: The surgical technique was performed on a 75-year-old man with a history of DSAEK to intraoperatively treat DMD, which occurred during vitrectomy in the left eye. A fine needle mounted on a syringe was inserted into the supra-Descemet's space under iOCT guidance. The location of the needle was easily identified by its high reflection. The interface fluid was safely aspirated under excellent visualization of the needle tip and the interface. Successful aspiration of the interface fluid was confirmed via iOCT imaging at the end of the surgery. The graft has remained well attached to the cornea throughout the one-year postoperative follow-up.

Conclusion and importance: iOCT-guided surgical interventions provide a safe and accurate approach for treating intraoperative complications in eyes with a history of DSAEK.

1. Introduction

Descemet's stripping automated endothelial keratoplasty (DSAEK) has become the most common type of corneal endothelial transplantation procedure.¹ Descemet's membrane detachment (DMD) is a sight-threatening complication of intraocular procedures, including cataract surgeries, which requires prompt diagnosis and optimal management to improve anatomical and visual outcomes.²

Notably, the advent of intraoperative optical coherence tomography (iOCT) has revolutionized the clinical assessment of ocular conditions intraoperatively, and its usefulness in various ophthalmic surgical procedures has been well reported.^{3,4}

Herein, we describe an iOCT-guided surgical intervention for the treatment of DMD that occurred during vitrectomy in a patient with a

previous history of DSAEK.

2. Case report

A 75-year-old man, who had undergone DSAEK for the treatment of bullous keratopathy (BK) four years ago, underwent Baerveldt glaucoma implant surgery for the management of glaucoma. Complications of persistent hyphema and vitreous hemorrhage (VH) after Baerveldt glaucoma implant surgery had not improved over two months. The best-corrected visual acuity in the left eye was hand motion after Baerveldt glaucoma implantation because of VH. Then, as VH had not improved, he underwent a 25-gauge pars plana vitrectomy (PPV) with the RESIGHT® (Carl Zeiss Meditec, Inc., Dublin, CA, USA) non-contact wide-angle viewing system for VH in his left eye. Iris retractors

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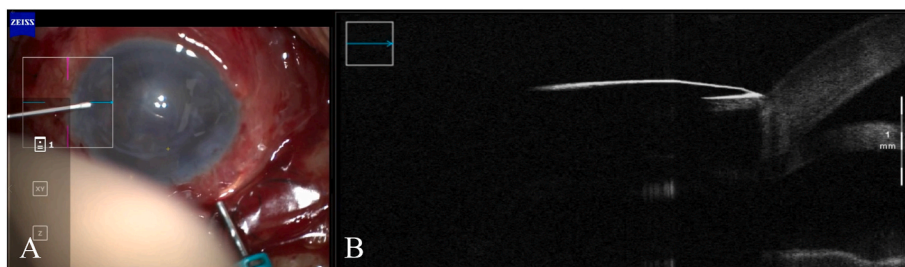


Fig. 1. (A) Image of the patient’s eye with the crosshair marks indicating the planes of the intraoperative optical coherence tomography (OCT) scan. (B) The needle position can be observed by virtue of the reflective nature of the metal needle.

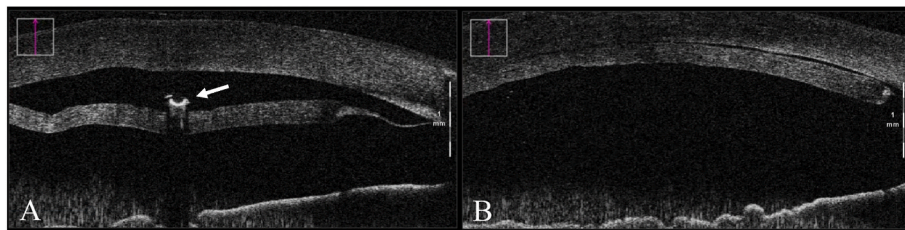


Fig. 2. (A) iOCT image demonstrating the needle tract (arrow) in the supra-graft space before drainage. (B) An iOCT image demonstrating minimal interface fluid between the detached graft and host corneal stroma after aspiration.

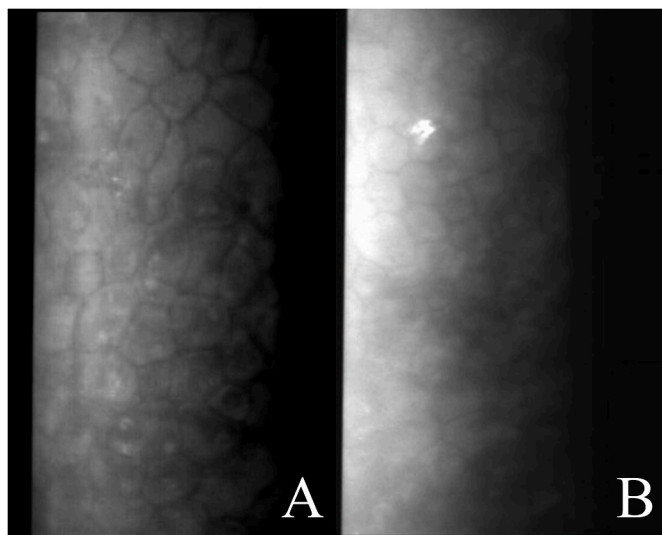


Fig. 3. Specular microscopy imaging of the corneal endothelium for the left eye (A) pre-vitrectomy and (B) post-vitrectomy.

(Handaya Co Ltd, Tokyo, Japan) were used because of insufficient mydriasis and opacity in the central cornea. Although the vitrectomy was uneventful, DMD was observed at the end of surgery; this occurred following the stromal hydration for closure of the wound created for iris retraction, which was made by a slit knife (MANI, Inc., Tochigi, Japan).

We used an operating microscope (Lumera 700; Carl Zeiss Meditec, Inc.) with iOCT via an ophthalmologic operating system (Callisto; Carl Zeiss Meditec, Inc.) to visualize the anterior segments and identify the site of graft detachment (Video 1). A 30-gauge sharp-tip needle (TSK Laboratory, Tochigi, Japan) mounted on a 1-ml syringe was gently inserted into the anterior chamber through a small paracentesis under microscope-integrated iOCT guidance (Fig. 1A and B). The needle tip was then slowly advanced into the supra-Descemet’s space. The movement was safely and reliably performed by confirming the location of the needle by its high reflection on raster iOCT scanning (Figs. 1B and 2A). After confirming the position of the needle tip (Fig. 2A), the interface

fluid between the graft and the corneal stroma was removed by active aspiration under negative pressure, which reduced the fluid volume.

Supplementary video related to this article can be found at <https://doi.org/10.1016/j.ajoc.2022.101623>.

After confirming fluid reduction, the needle was carefully withdrawn from the anterior chamber. Thereafter, air was injected into the anterior chamber using another syringe. At the end of the procedure, an iOCT scan showed little interface fluid in the central region (Fig. 2B). One week postoperatively, visual acuity improved to 20/32 in the operated eye. The graft was confirmed to be well attached upon examination and the condition of the corneal endothelium was not deteriorated on specular microscopy at the 14-month follow-up (Fig. 3).

A Rho kinase inhibitor eye drop that had been initiated prior to this surgery was continued over three years to protect corneal endothelial cell regeneration.

3. Discussion

DMD is a common complication of intraocular procedures, such as cataract surgery. DMD occurs in almost 43% of cases after cataract surgery. Although most cases of DMD appear to reattach spontaneously, this has not yet been conclusively substantiated.⁵ If untreated, DMD may cause complications, such as corneal opacity, corneal edema, and BK.

Descemet’s membrane is the basement membrane of the corneal endothelial cells, which is metabolically active. It functions as an endothelial pump that regulates water content and maintains corneal translucence. The aqueous humor provides nutrition to the Descemet’s membrane-endothelial complex. Therefore, large, persistent DMDs damage endothelial cells and endothelial pump function, leading to corneal decompensation.

Hence, prompt detection and repair of DMDs are warranted. Major interventions for DMDs include observation, topical medication use, intracameral air or gases injection, descemetopexy, Descemet’s membrane sutures, and combined techniques. Conventionally, DMD is treated by injecting air into the anterior chamber.⁶ The choice and timing of intervention depends on various factors, including the surgeon’s experience.

The success of graft reattachment depends on the degree of adherence between the donor and recipient stroma.⁷ Similarly, to achieve

anatomical improvement in DSAEK, drainage of the interface fluid is warranted to effectively prevent Descemet's membrane detachment.⁸

The recent developments in iOCT technology facilitate the evaluation of residual fluid during surgery.^{3,4} Two-dimensional iOCT-guided visualization allows surgeons to predict anatomical variations and accurately assess an object of interest. During DSAEK, iOCT guidance is useful to prevent fluid retention between the graft and corneal stroma, which is considered as the probable cause of graft reattachment failure in most cases.⁹

Image-guided procedures are widely performed as they allow real-time visualization of the relative positions of medical devices and the surrounding tissues, thereby improving safety in internal medicine procedures such as venous cannulation.¹⁰

However, to the best of our knowledge, no report has described iOCT-guided surgical interventions to treat an intraoperative complication of DMD caused by prior DSAEK. In our case, we assessed the interface fluid, and the orientation and location of the surgical needle. The present study findings show that iOCT facilitates real-time intraoperative imaging and can impact surgical decision-making by providing tomographic information of intraocular structures. Surgical techniques guided by iOCT provide faster access to target tissues, have a relatively low technical failure rate, facilitate a reduction in complications, reduce surgical time, improve postoperative outcomes, and contribute to better decision-making by the practitioner.

Our technique is relatively safe and simple to perform; therefore, it is a highly reproducible surgical intervention for intraoperative management of DMD. Further research and longer follow-up times are needed to provide information on possible unexpected complications caused by iOCT guidance during treatment of DMD by needle aspiration drainage.

In cases wherein the graft detaches along with the Descemet's membrane, the space between the corneal stroma and the graft is inaccessible. Hence, the aspiration technique presented in this report could be performed. For cases in which the graft detaches from the host Descemet's membrane, air should be injected into the anterior chamber as the first step to keep the graft pressed against the stroma. This would be similar to the procedure done in DSAEK. Moreover, iOCT has a few limitations, including its cost and the time required by the surgeon to become accustomed to the use of a foot pedal for optimal imaging.

4. Conclusions

Herein, we presented a novel iOCT-guided procedure for treating intraoperative DMD. This alternative approach provides excellent real-time visualization of the relative positions of the needle and surrounding tissues, thereby having the potential to improve the safety and accuracy of Descemet's reattachment procedures.

Patient consent

The patient provided written consent to publish the case report.

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Conflicts of interest

None.

Institutional review board approval

None.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Availability of data and materials

All data supporting our findings are provided within the manuscript.

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