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miOCT Guided Descemet Membrane Endothelial Keratoplasty (DMEK) and Deep Anterior Lamellar Keratoplasty (DALK)

Introduction

miOCT is used in various lamellar keratoplasty procedures as an aid to decision-making.[1,2] It offers increased sensitivity in hazy corneas with poor visualization. With this microscope, there is typically no need to adjust the angle of the OCT, since an entire corneal “cube” is obtained and can be captured to review individual frames during or after the surgery.

It enables us to visualize tissues to a certain extent. It also allows the instrument to reach a virtual cross-section of the region of interest, thereby allowing to precisely identify different tissue structures, tissue thickness and so on without interrupting the procedure with great precision.

Descemet Membrane Endothelial Keratoplasty

miOCT helps in various surgical steps of Descemet Membrane Endothelial Keratoplasty (DMEK).[3,5] During the Descemet scoring of the host cornea, any area of retained Descemet membrane tag can be easily picked up with the help of miOCT even in the presence of hazy media.

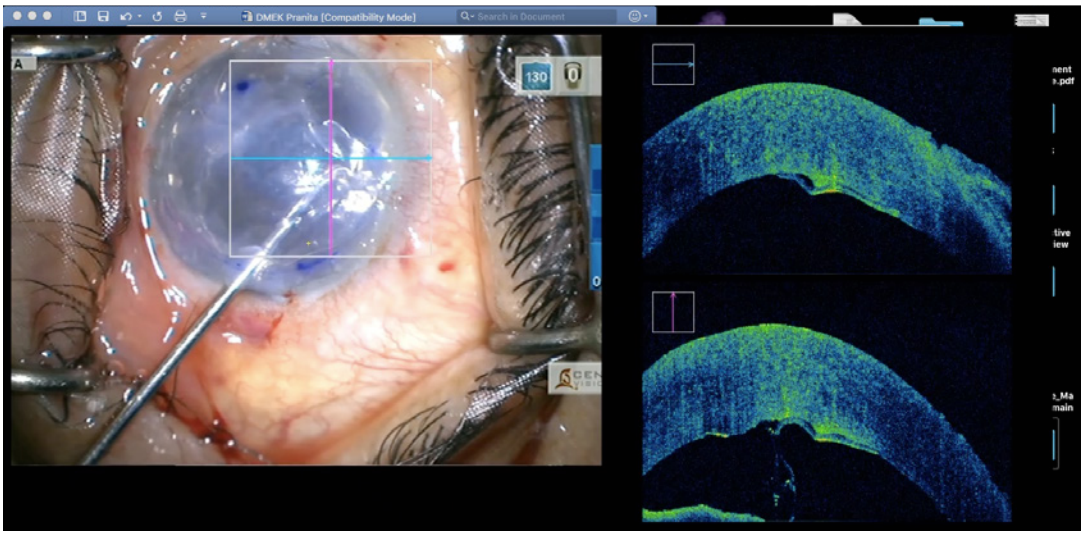

Figure 1 - Retained DM tag visualized in miOCT removed with the help of ILM forceps in DMEK

Therefore, complete removal of the residual DM tags can be ensured with its aid. This is a critical step for post-operative graft attachment.

Also, miOCT helps in the identification of areas of missing DM in the host cornea before descemetorrhexis. miOCT also guides the surgeon to avoid unnecessary attempts of DM scrapping that can result in a post-operative stromal haze. During the injection of the DMEK roll in the anterior chamber, the miOCT can help the surgeon in identifying the orientation of the DM roll in the injector.

This is because the orientation of the injector is changed to allow the injection of the DM roll in the correct orientation. Also before the injection of air, the orientation of the DM roll in the anterior chamber can be assessed with miOCT.

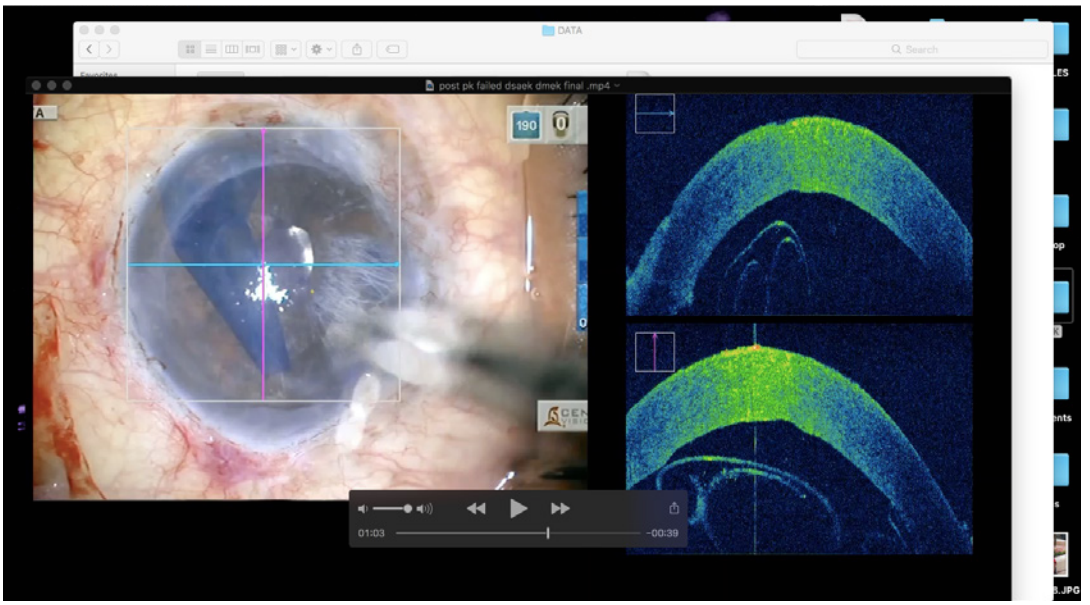

Figure 2 - Orientation of DMEK roll in the anterior chamber visualized in miOCT prior to injection of air (inverted DMEK roll)

This is especially important when the exact orientation of the 'S' mark on the donor tissue is difficult to identify due to corneal haze during the surgery. Peripheral DM folds in the graft and their orientation is precisely assessed with this equipment. It also helps in the unfolding of donor tissue. This reduces the surgical time as well as inadvertent damage to the graft with repeated attempts to unfold it. At the end of the surgery, mi-OCT helps to visualize the attachment of the graft to the host cornea. Even small areas of fluid pockets in the interface can be detected with the help of miOCT, which could be otherwise missed and resulted in unexpected post-operative graft detachment. Even though hazy media is a relative contraindication while selecting a case for DMEK as it results in poor visualizing of the DM tags, DMEK roll, and the S mark, with the use of miOCT these difficult situations during the surgery can be overcome.

Deep Anterior Lamellar Keratoplasty

miOCT has been successfully used for various anterior lamellar keratoplasty surgeries.[2] It is exceptionally useful while performing deep anterior lamellar keratoplasty (DALK) and increases the safety of this procedure. It leads the surgeon to evaluate the trephination depth in DALK, which gives precise identification of the accurate preparation depth. Very low or significantly deep trephination depths would, therefore, be accurately observed before progressing to the next step. Needle insertion into the stroma at 60% depth can be precisely examined with the miOCT.

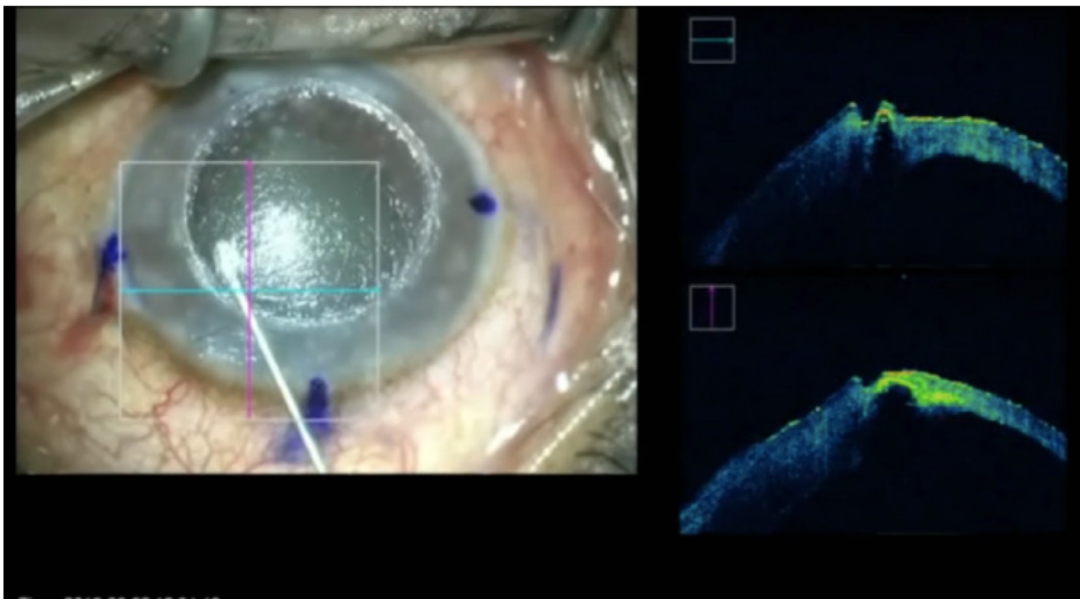

Figure 3 - Depth of needle in the cornea assessed with miOCT prior to injection of air in DALK

Air injection into the posterior stroma while attempting to create a big bubble sometimes results in diffuse stromal opacification.

The miOCT can be extremely useful at this step to identify if a big bubble has formed beneath this area of stromal opacification. In the case of incomplete bubble formation, this instrument can help us in precise location where a nick can safely be made without damaging the underlying Descemet Membrane (DM).

Once the anterior stroma is dissected and the bubble is punctured to inject OVD into the plane, the gap created between the DM and posterior stroma can be visualized through mi-OCT thereby guiding the plane of dissection for excising the posterior stroma.

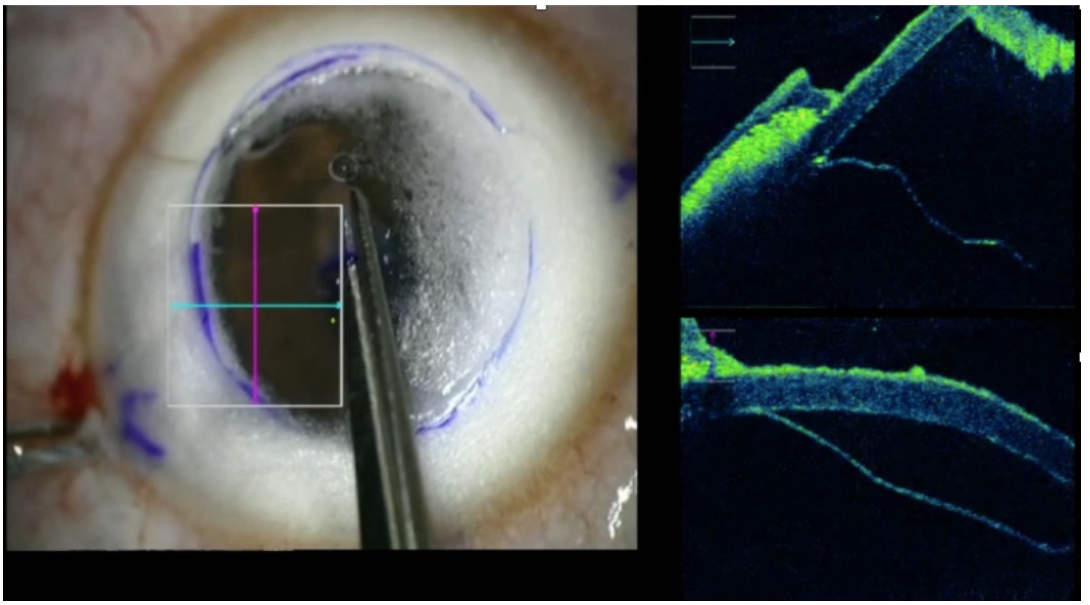

Figure 4 - miOCT guided visualisation of gap between the posterior corneal stroma and DM during dissection in DALK

During posterior stromal dissection, any bulge of DM can be detected on miOCT thus guiding the surgeon to avoid accidental DM perforation.

miOCT gives the surgeon the confidence to attempt deeper dissection or possibly attempt another big bubble following the first failed attempt to create one when significant stroma is still present.

During manual DALK, miOCT can guide the surgeon to decide the endpoint of dissection based on the residual corneal thickness.

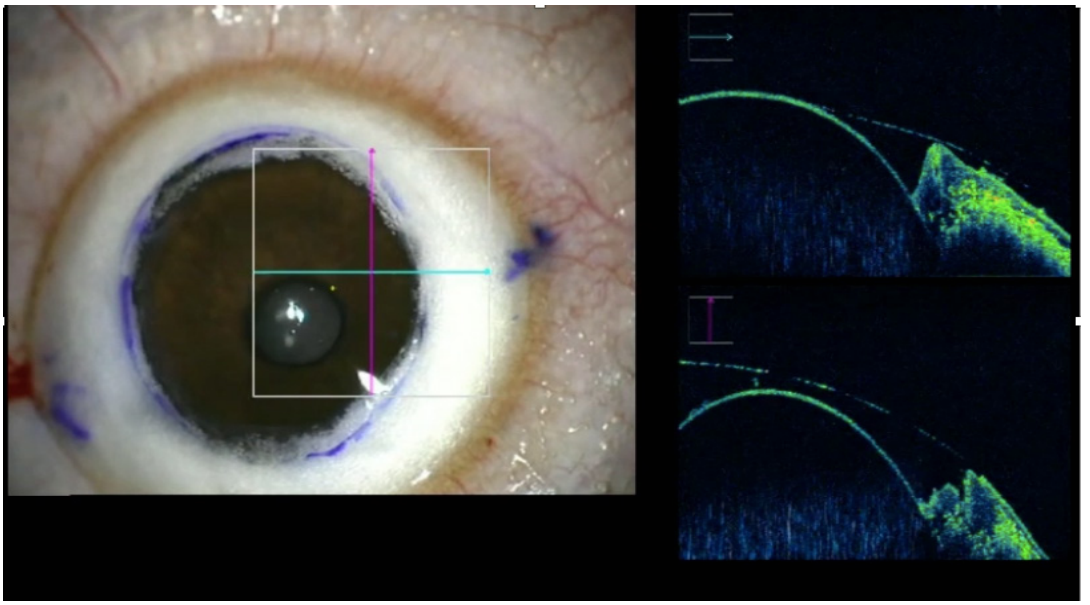

Figure 5 - miOCT guided visualisation of the residual corneal bed (bare DM) after dissection of posterior corneal stroma in DALK

Graft placement onto recipient bed and suturing depth can also be monitored preventing accidental micro-perforation of DM at this step.

At the end of the surgery, the interface can be assessed to ensure complete graft attachment. miOCT is an invaluable tool in difficult situations like descemetocele and healed hydrops with stromal scarring.

Careful use of miOCT in the various surgical maneuvers of DALK can reduce the chance of DM perforation and penetrating keratoplasty conversion.

With an improved understanding of the role of miOCT in lamellar corneal surgeries, it has become a useful guide for the corneal surgeons to further enhance the safety and clinical outcomes of these procedures.

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References

1. Hallahan KM, Cost B, Goshe JM, Dupps WJ, Srivastava SK, Ehlers JP. Intraoperative Interface Fluid Dynamics and Clinical Outcomes for Intraoperative Optical Coherence Tomography-Assisted Descemet Stripping Automated Endothelial Keratoplasty From the PIONEER Study. Am J Ophthalmol. 2017 Jan;173:16–22.

2. Steven P, Le Blanc C, Lankenau E, Krug M, Oelckers S, Heindl LM, et al. Optimising deep anterior lamellar keratoplasty (DALK) using intraoperative online optical coherence tomography (iOCT). Br J Ophthalmol. 2014 Jul;98(7):900–4.

3. Saad A, Guilbert E, Grise-Dulac A, Sabatier P, Gatinel D. Intraoperative OCT-Assisted DMEK: 14 Consecutive Cases. Cornea. 2015 Jul;34(7):802–7.

4. Cost B, Goshe JM, Srivastava S, Ehlers JP. Intraoperative optical coherence tomography-assisted descemet membrane endothelial keratoplasty in the DISCOVER study. Am J Ophthalmol. 2015 Sep;160(3):430–7.

5. Steven P, Le Blanc C, Velten K, Lankenau E, Krug M, Oelckers S, et al. Optimizing descemet membrane endothelial keratoplasty using intraoperative optical coherence tomography. JAMA Ophthalmol. 2013 Sep;131(9):1135–42.