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A Simple Technique to Aid Visualization of the Graft During Descemet Membrane Endothelial Keratoplasty in Complicated Cases

Komplike Olgularda Descemet Membran Endotelyal Keratoplasti Sırasında Greft Görünürlüğünü Arttırmak İçin Basit Bir Yöntem

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ABSTRACT Objective: To present an alternative illumination technique in patients with clouded or opaque corneas, undergoing Descemet Membrane Endothelial Keratoplasty (DMEK) and to report the clinical outcomes. **Material and Methods:** Ten cases who underwent DMEK surgery between September 2016 and September 2017 with poor visualization of the anterior chamber due to corneal opacities, were included in the study. Medical records were reviewed retrospectively. Wilcoxon signed-rank test was used to compare pre- and postoperative clinical findings. **Results:** Six patients had bullous keratopathy and four patients had a previous corneal transplant failure. During graft unfolding and centration, the intensity of the oblique field component of the operating microscope was dimmed and only coaxial illumination was used to enhance the red reflex. This was useful for observation of the correct orientation of the graft and allowed successful graft positioning in all cases. Mean postoperative follow-up duration was 18.3±4.1 months. All patients had increased visual acuity. Mean Snellen best corrected visual acuity increased from 0.08±0.05 to 0.39±0.14 (p=0.16) at the third month and to 0.53±0.09 (p=0.02) at the end of the follow-up. Mean central corneal thickness decreased from 873.4±64.3 µm to 588±39.2 µm (p=0.01). Eight patients (80%) had a clear cornea centrally, at the third month. Two patients underwent penetrating keratoplasty (PK) due to unsatisfactory vision after DMEK. **Conclusion:** In cases with corneal opacities, retroillumination technique may improve the outcome of DMEK surgery by preventing the formation of an inverted graft. In 20% of these complicated cases, consequent PK may be needed.

Keywords: Clouded cornea; descemet membrane endothelial keratoplasty; graft orientation; retroillumination

ÖZET Amaç: Opak veya ileri derecede bulanık korneası olan hastalarda Descemet Membran Endotelyal Keratoplasti (DMEK) sırasında kullanılabilecek alternatif bir illüminasyon tekniğinin tarif edilmesi ve klinik sonuçların bildirilmesi. **Gereç ve Yöntemler:** Kliniğimizde Eylül 2016 ile Eylül 2017 arasında DMEK cerrahisi uygulanmış, korneal opasite veya bulanıklık nedeni ile cerrahi sırasında ön kamaranın yeterli derecede seçilemediği 10 olgu dahil edilmiştir. Hasta kayıtları retrospektif olarak incelenmiştir. Pre- ve postoperatif klinik bulguların karşılaştırılması için Wilcoxon signed-rank test kullanılmıştır. **Bulgular:** Altı hastada büllöz keratopati ve 4 hastada geçirilmiş penetran keratoplasti (PK) sonrası greft yetmezliği mevcuttu. Greft açılması ve santralizasyonu sırasında cerrahi mikroskop ışığının oblik bileşeni kısılarak sadece koaksiyel aydınlatma kullanılmış ve bu sayede kırmızı refle yansıması arttırılmıştır. Bu şekilde elde edilen retroillüminasyon sayesinde greftin açılması sırasında greft oryantasyonu daha kolay belirlenebilmiş ve tüm hastalarda greft başarılı bir şekilde yerleştirilebilmiştir. Postoperatif takip süresi ortalama 18,3±4,1 ay olarak belirlenmiştir. Takipte tüm hastalarda görme keskinliğinde artış saptanmıştır. Ortalama Snellen en iyi düzeltilmiş görme keskinliği 0,08±0,05'den, üçüncü ayda 0,39±0,14'e (p=0,16), ve takip sonunda 0,53±0,09'a (p=0,02) yükselmiştir. Ortalama santral kornea kalınlığı 873,4±64,3 µm'den takip sonunda 588±39,2 µm'ye inmiştir (p=0,01). Takip sonunda, 8 hastada (%80) kornea görme aksında saydam idi. Greft yetmezliği nedeniyle DMEK uygulanmış olan 2 hastaya, düşük görme seviyesi nedeni ile PK uygulandı. **Sonuç:** Kornea opasitesi veya ileri derecede bulanıklığı bulunan hastalarda DMEK cerrahisi sırasında retroillüminasyon tekniğinin kullanılması, cerrahi sırasında ön kamarada greft oryantasyonunun belirlenmesine yardımcı olmakta ve geftin ters yerleştirilme olasılığını düşürmektedir. Bu komplike olguların %20'sinde takipte PK uygulanması gerekebilmektedir.

Anahtar Kelimeler: Bulanık kornea; descemet membran endotelyal keratoplasti; greft oryantasyonu; retroillüminasyon

Descemet's membrane endothelial keratoplasty (DMEK) has evolved to become a commonly performed, successful lamellar corneal transplantation technique since it was first described by Melles et al. in 2006.[1-3] However, DMEK is technically more difficult to perform than other lamellar keratoplasty techniques and the learning curve is steeper.[4] One of the most challenging steps is the apposition of the graft to the recipient stroma in the correct orientation, with the endothelial side facing the anterior chamber. Few techniques have been described to aid in this step. The DMEK graft tends to form a double roll configuration in the anterior chamber and the sides should be curled upward in the correct orientation. This may be checked with insertion of a 30-gauge Rycroft cannula inside the curves, in the anterior chamber (Moutsouris sign).[2] Pre-marking of the Descemet roll with an S stamp is another technique used to eliminate upside-down graft implantation.[5] However, for these techniques to be performed, the anterior chamber should be visible, which may not be the case in patients with advanced corneal edema or stromal opacities. In those challenging cases, some other techniques including slit beam illumination, endoilluminator-assisted transcorneal illumination, or the use of intraoperative Optical Coherence Tomography have been described.[6-8]

Herein, we describe an easy technique, customizing illumination by the operating microscope to enhance the red-reflex, which enables easy identification of graft orientation as well as visualization of the graft during DMEK surgery.

MATERIALS AND METHODS

Retroillumination- assisted DMEK surgery was performed in 10 eyes of 10 patients with severely clouded or opaque corneas, between September 2016 and September 2017 at Başkent University Faculty of Medicine, Department of Ophthalmology, Ankara, Turkey. All surgeries were performed under topical anesthesia by the same experienced anterior segment surgeon (DDA). The study was performed according to the Declaration of Helsinki. Ethics committee approval was obtained from the university (Project nb: KA18/429). The patients were fully informed about the surgical procedure, after which they provided informed consent. Patient records were reviewed retrospectively for evaluation of the clinical results. Wilcoxon signed-rank test was used to compare pre- and postoperative visual acuity and central corneal thickness (CCT).

A 3.0 mm wide clear corneal tunnel incision was performed at the 12-o'clock surgical position, with a slit knife. Two side ports were created at 10:30, 1:30, clock positions with a surgical side port knife under local anethesia. A descemetorhexis of 8.5 mm was performed using a reversed Sinskey hook (DORC International, Zuidland, the Netherlands) under air. In patients with marked corneal epithelial edema, the corneal epithelium was scraped using a side port knife before the descemetorhexis step, to obtain a clearer cornea. Intracameral acetylcholine (Miochol; Bausch and Lomb, Bridgewater, New Jersey, USA) was injected to constrict the pupil.

An 8 mm pre-stripped Descemet's membrane graft was used which was obtained from the Eye Bank of Ankara Training and Research Hospital, Ankara, Turkey. The graft was rinsed with balanced salt solution in a bowl (Alcon Nederland BV, Gorinchem, Netherlands) and stained with 0.06% trypan blue (VisionBlue, Dutch Ophthalmic USA, Exeter, NH) for three minutes. The trypan blue was rinsed with balanced salt solution. After staining, the DMEK roll was gently injected into the anterior chamber using a curved glass injector. The main incision was closed by one 10-0 nylon suture. At this point, the graft orientation could not be assessed due to the clouded cornea (Figure 1a). To enhance visualization, the microscope (OPMI Lumera; Carl Zeiss Meditec, Inc., Dublin, CA) oblique illumination was switched off by the manual knob while leaving the coaxial beam fully open. Retroillumination was thereby maximized, and the red reflex was enhanced. Under this illumination setting, the graft localization and orientation could be fully assessed (Figure 1b).

The Descemet graft was unfolded using a "no-touch technique" under retroillumination.[2] After unfolding of the graft by taps to the cornea, air was

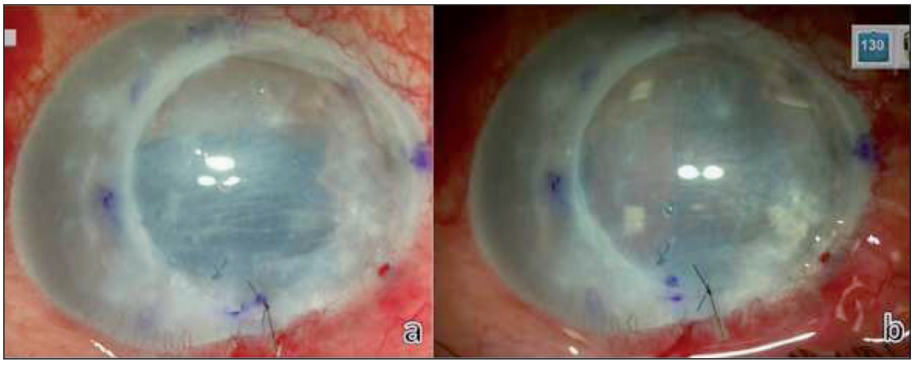

FIGURE 1: After injection of the Descemet's membrane graft into the anterior chamber, graft orientation could not be assessed due to the clouded cornea **(a)**. The microscope oblique illumination was simply switched off by the manual shutter knob while leaving the solitary coaxial beam 100% open. Retroillumination was thereby maximized and the red reflex was enhanced. Under this illumination setting, the graft localization and orientation could be fully assessed **(b).**

injected underneath the graft and apposition to host stroma was enabled. After 3 minutes, some air was exchanged with BSS and the intraocular pressure was checked manually. Subconjunctival cephazolin and betamethasone injection and topical instillation of moxifloxacin was performed. A bandage contact lens was applied. Postoperatively, supine position was recommended for 24 hours. Postoperative medications included topical moxifloxacin and prednisolone acetate ophthalmic solutions 6 times daily for 1 week which were tapered thereafter.

RESULTS

Six patients had bullous keratopathy and four patients had a previous corneal transplant failure. Mean age of the patients was 64.2±5.9. Male to female ratio was 5/5. All patients underwent DMEK. Initially, visualization of the graft position was not possible during the graft unfolding step, due to prominent corneal clouding and/or corneal opacities, in all eyes. After the oblique illumination of the microscope was switched off and only coaxial illumination was used, the graft could be visualized more clearly. Successful graft manipulation and observation of correct graft orientation were possible using this illumination technique. Retroillumination obtained using the coaxial light of the microscope also increased visualization of the graft position after the injection of the air bubble. Scraping and removal of the edematous corneal epithelium before descemetorhexis was also helpful for visualization of the Descemet's membrane folds and borders during the descemetorhexis step. All patients had increased visual acuity during follow up. One patient had a partial graft detachment at the first day and the graft was re-attached by injection of air into the anterior chamber. Mean duration of postoperative follow-up was 18.3±4.1 months. Mean best corrected Snellen visual acuity increased from 0.08±0.05 to 0.39±0.14 (p=0.16) at the postoperative third month and to 0.53±0.09 (p=0.02) at the end of the follow-up. Mean CCT decreased from 873.4±64.3 μm to 588 ± 39.2 μm. Eight patients had a clear cornea centrally, at the third month. Two patients with stromal opacities due to previous graft failure underwent PK due to unsatisfactory vision after DMEK at the 5th and 6th postoperative months.

DISCUSSION

Descemet's membrane endothelial keratoplasty (DMEK) is becoming an increasingly popular lamellar corneal transplantation technique since it is associated a with lower rate of rejection and better refractive results, when compared to PK and Descemet's stripping endothelial keratoplasty.[9] However, DMEK is associated with a steeper learning curve. Technical difficulties in many steps during the procedure, including graft harvesting, handling and assessment of graft orientation need to be overcome. The thin graft which tends to form a double scroll is especially difficult to visualize after injection into the anterior chamber.

The use of trypan blue aids in the visualization of the graft however the dye tends to fade during the last steps of surgery. Although repeated dying can be performed with injection of the dye into the anterior chamber, endothelial toxicity is a concern that needs to be kept in mind.[10] In challenging cases with a hazy cornea, additional visualization techniques are useful. Therefore, tissue modifications have been developed with the purpose of aiding correct orientation of the graft. Punching several cuts along the graft periphery is one of these possible modifications.[11] Placement of an S-shaped ink stamp on the graft is a more widely accepted technique which permits visual confirmation of proper orientation.[12] However, these may not be available to most DMEK surgeons around the world, including us, since they require additional complicated steps during graft preparation. Furthermore, the visibility of the S-stamp may be poor due to a lightly marked S-stamp, a dark iris background, excessive graft staining with trypan blue, corneal stromal or epithelial edema and corneal scarring.[13]

In cases with a hazy cornea where assessment of graft orientation is difficult, illumination techniques including handheld slit beam illumination, endoilluminator-assisted transcorneal illumination and posterior chandelier illumination have been described.[6,7,14] However, all of these require additional instrumentation during surgery. The major advantage of using retroillumination as described above is its not requiring additional instrumentation and being simply obtained by switching of the oblique illumination source of the operating microscope by the manual shutter knob.

Limitations of the study include a relatively small number of patients, lack of prospective and comparative nature.

CONCLUSION

In conclusion, the described easy retroillumination technique aided visualization of the graft in the anterior chamber and its orientation in a group of patients with advanced corneal haze. Graft orientation could be assessed in those complicated cases by simply enhancing the red reflex. This simple and effective technique should prove useful to corneal surgeons around the world performing DMEK surgery and decrease the rate of inverted grafts in complicated cases. Patients with prominent stromal scars may not have satisfactory final vision and need a consequent PK.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and/or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

All authors contributed equally while this study preparing.

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