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Case Report

Mini descemet membrane stripping (m-DMES) in patients with Fuchs' endothelial dystrophy: A new method

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Abstract

We present two cases with focal corneal edema due to Fuchs' endothelial dystrophy that were successfully treated with mini Descemet membrane stripping (m-DMES) (diameter of 3–4 mm; at the area of preexisting focal corneal edema) without endothelial replacement during cataract surgery. Specular microscopy demonstrated Fuchs' endothelial dystrophy and histopathologic evaluation confirmed the diagnosis. Anterior segment optical coherence tomography and confocal microscopy were used for the evaluation of the corneal tissue recovery course after the surgical procedure. In both patients, we observed an initial aggravation of corneal edema in the area of DM removal for two months followed by gradual improvement. At four months postoperatively, corneal edema had completely regressed resulting in corneal clearance and visual acuity improvement in both cases. M-DMES without graft insertion represents a promising alternative surgical technique that could be applied in specific cases of Fuchs' endothelial dystrophy with focal corneal edema.

Keywords: Corneal edema, Descemet membrane, Fuchs' dystrophy, Mini central DM striping, Partial removal

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Introduction

Fuchs' endothelial dystrophy is one of the leading causes of corneal edema affecting mostly the aging population. The surgical management of corneal edema due to Fuchs' endothelial dystrophy includes penetrating keratoplasty and lately selective posterior lamellar and endothelial keratoplasty (EK) techniques, such as Descemet stripping -automated-endothelial keratoplasty (DSEK/DSEAK) and Descemet membrane endothelial keratoplasty (DMEK).[1] The EK techniques have been established as the preferred for the surgical management and restoration of corneal edema in endothelial disorders due to faster visual rehabilitation, better refractive outcomes, better tectonic stability and less suture related complications in comparison to penetrating keratoplasty.[2]

However, spontaneous corneal clearing has been observed even in cases with detached graft attributed to endothelial cells repopulation.[3–5] Also, DM stripping without endothelial replacement has been described as a potential surgical procedure in patients with Fuchs' dystrophy leading to corneal clearing and edema reduction due to endothelial cells repopulation.[6] Nevertheless, the effectiveness of this technique is rather controversial as in most cases the clinical outcomes were discouraging.[7,8]

We herein present two patients with focal corneal edema due to Fuchs' dystrophy undergone mini DM

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stripping (m-DMES) without graft insertion during cataract surgery and achieved complete corneal transparency postoperatively.

Case reports

Case 1

A 72-year-old female patient presented to our clinic for consultation because of gradual decrease of visual acuity and foreign body sensation (especially in the morning hours) in her right eye. Uncorrected distance visual acuity (UDVA) was 20/200 in the right eye and 20/50 in the left eye, while corrected distance visual acuity (CDVA) was 20/63 and 20/25, respectively. Slit lamp examination revealed bilateral Fuchs' endothelial dystrophy, with focal, paracentral stromal edema in her right eye (Fig. 1A). In addition, nuclear sclerotic and anterior cortical cataract were observed in her right eye and posterior chamber intraocular lens (PC-IOL) in her left eye. Fundus examination was unremarkable and the intraocular pressure was within normal limits in both eyes. Ultrasound pachymetry (Corneo-Gage Plus; Sonogage, Inc, Cleveland, Ohio, USA) estimated corneal thickness of 610 μm and 559 μm in her right and left eye, respectively.

Case 2

A 72-year-old female patient, undergone DMEK in her right eye three years earlier, presented to our clinic because of visual acuity deterioration in her left eye. At presentation, UDVA was 20/50 in the right eye and 20/200 in the left eye, while CDVA was 20/32 and 20/80, respectively. Slit lamp examination showed clear and compact cornea with attached graft in the right eye and a hazy area of focal and central stromal edema with guttata and pigment deposits on the endothelium in her left eye, as a result of Fuchs' endothelial dystrophy (Fig. 1B). Moreover, PC-IOL implantation and nuclear sclerotic cataract were observed in her right and left eye, respectively. Fundus examination was unremarkable and the intraocular pressure was within normal limits in both eyes. Ultrasound pachymetry (Corneo-Gage Plus; Sonogage, Inc, Cleveland, Ohio, USA) estimated central corneal thickness of 520 μm and 630 μm in her right and left eye, respectively. Specular microscopy (Tomey EM-3000; Tomey Corporation, Nagoya, Japan) revealed confluent corneal guttata and loss

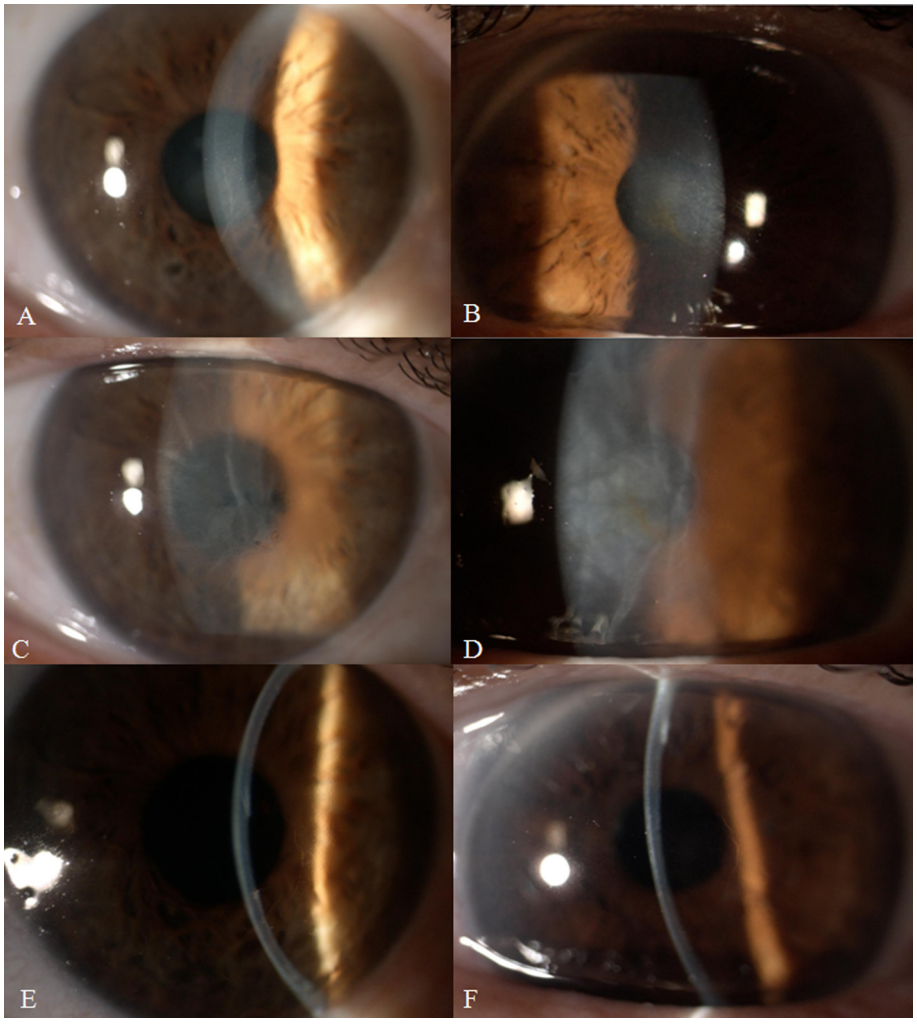

Fig. 1. Preoperative slit lamp image showing focal corneal edema due to Fuchs' endothelial dystrophy, in patient 1 (A) and patient 2 (B). Slit lamp image at two months postoperatively, showing severe corneal stromal edema and folds in the DM-stripped area in patient 1 (C) and in patient 2 (D). Slit lamp image at four months postoperatively showing corneal clarity, especially in the area of DM removal, in patient 1 (E) and in patient 2 (F).

of endothelial cells structure bordering to normal endothelial cells structure (Fig. 2A).

Patients were thoroughly informed about their clinical condition, the risks and benefits of combined surgical treatment of phacoemulsification, PC-IOL implantation and partial DM removal in the area of the focal edema and signed consent according to the institutional guidelines and in compliance with the Declaration of Helsinki. Institutional Review Board (IRB)/Ethics Committee approval was obtained.

Surgical technique and follow-up

First uncomplicated phacoemulsification was performed through a 2.75 mm clear corneal incision followed by implantation of a single piece acrylic IOL (Acrysoft; Alcon Laboratories, Fort Worth, Texas, USA) in the capsular bag. Immediately after IOL implantation and with the anterior chamber fulfilled with cohesive viscoelastic, a mini DM stripping (m-DMES) without graft insertion was followed. Specifically, a partial focal removal of DM was performed in the area corresponding to corneal edema with a reverse sinskey hook. Special care was taken to avoid scraping the posterior stroma during the stripping procedure. In case 1 stripping was within a diameter of 3 mm and in case 2 within a diameter of 4 mm. Postoperative medication included nepafenac suspension 0.1% (Nevanac; Alcon Laboratories, Inc) for 1 month and chloramphenicol/dexamethasone drops (Dispersadron; Thea Laboratories, Inc) 6 times daily for 1 month.

On the first postoperative day, visual acuity was finger counting while slit lamp examination demonstrated corneal stromal edema (especially in the area of DM removal) and folds in both cases. The intraocular pressure was within normal limits. At one week postoperatively, the examination revealed no improvement of the clinical findings and the central corneal thickness was estimated at 710 μm (case 1) and 820 μm (case 2).

At two months postoperatively, UDVA was 20/200 in both cases. Slit lamp examination demonstrated posterior defect of DM with severe corneal stromal edema folds in the DM-stripped area and corneal bullae in both patients (Fig. 1C and D). Anterior segment optical coherence tomography (AS-OCT, Visante Optical Coherence Tomography 3.0, and Carl Zeiss Meditec AG) was used for the evaluation of corneal thickness. In case 1, corneal thickness was measured 640 μm in the DM-stripped area and 609 μm outside the DM-stripped area, while in case 2 measured 801 μm and 769 μm, inside and outside the DM-striped area, respectively (Fig. 2B and C).

At four months postoperatively, UDVA was 20/25 and 20/100 while CDVA was 20/25 and 20/40, in case 1 and 2, respectively. Slit lamp examination revealed smooth and transparent cornea in both cases (Fig. 1E and F). AS-OCT measurements of corneal thickness were 566 μm (in the DM-stripped area) and 590 μm (outside the DM-striped area) in case 1, while measured 588 μm (in the DM-stripped area) and 612 μm (outside the DM-striped area) in case 2 (Fig. 2D and E). During the follow-up period (1 year for case 1 and 6 months for case 2) the cornea maintained its clearance, without recurrence of edema.

Histopathologic analysis of the removed DM part of the patient 2 revealed thickening of 20–28 nm of the patient's DM in comparison with the normal DM's thickness. Another interesting finding was the fact that the guttata in the peripheral part of the removed DM were relatively small, whereas in the central part of the removed DM their appearance was rather typical of Fuchs' endothelial dystrophy (Fig. 3A). Moreover, in the transmission electron microscopy analysis of the ultrastructure of the removed DM was visible three layers: the anterior banded layer (ABL), the posterior non-banded layer (PNBL) and the additional posterior banded layer (PBL) (Fig. 3B). The appearance of three layers consists of a significant histological feature in late-onset subtype of Fuchs' endothelial dystrophy.[9]

In addition, confocal microscopy (modified confocal scanning laser ophthalmoscope HRT II) imaging technique was applied in the case 2 in order to evaluate the endothelial layer of the cornea. The examination revealed areas with endothelial cells characterized by polymegathism and pleomorphism (Fig. 3C).

Discussion

EK techniques (DSEK/DSAEK and DMEK) have become the surgeons' choice of preference in order to manage the Fuchs' endothelial dystrophy and restore corneal transparency.[2] However, spontaneous corneal clearing has been

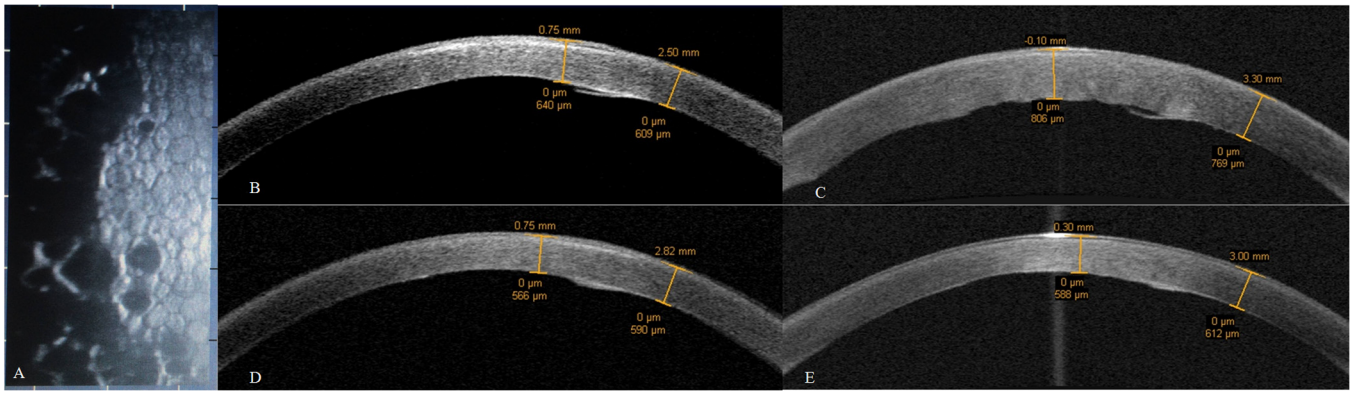

Fig. 2. Specular microscopy image of patient 2 showing confluent corneal guttata (darkened areas -holes in the endothelial mosaic) and loss of endothelial cell structure bordering to normal endothelial cells structure, while the patient was fixating slightly eccentrically than the fixation target of the instrument in order to achieve this display (A). At two months postoperatively, high resolution AS-OCT scan showed aggravation of corneal edema in the area of DM removal, in patient 1 (B) and in patient 2 (C). At four months postoperatively, high resolution AS-OCT scan showed corneal edema regression in the area of DM removal, in patient 1 (D) and in patient 2 (E).

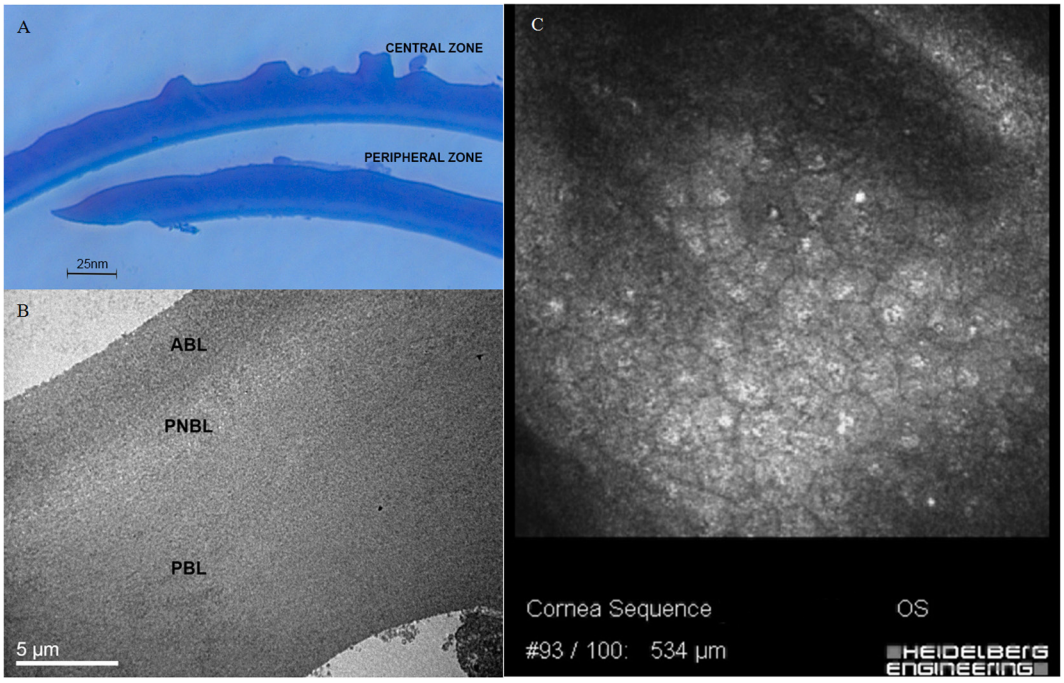

Fig. 3. Histopathologic image (A) of the DM removed from patient 2 showing that the guttata in the peripheral part of DM were relatively small whereas in the central part of DM their appearance was rather typical of Fuchs' endothelial dystrophy. Note that both in the central and in the peripheral zones the DM demonstrates significant thickening (20–28 nm) in comparison with normal DM. Transmission electron microscopy (B) of DM with Fuchs' endothelial dystrophy, low-magnification picture of anterior banded layer (ABL), posterior non-banded layer (PNBL) and posterior banded layer (PBL). Confocal microscopy image (C) showing the morphology of the endothelial cells in the DM-stripped area characterized by polymegathism and pleomorphism.

reported in cases with complicated EK, in which the donor transplant failed primarily or detached postoperatively.[3,4] Theoretical pathways of endothelial cells migration, spread or regeneration have been reported as a possible explanation for recovery of corneal transparency in these cases.[3,4]

Further, several cases with Fuchs' endothelial dystrophy undergone DM removal without endothelial replacement have been reported to achieve corneal clearance.[6,8] The authors' explanation of corneal clearance is based on the hypothesis of endothelial cell repopulation. However, this technique seems to have limited applicability in larger series of patients and poor efficacy in long-term follow-up.[7,8] Young patients age and diagnosis of posterior polymorphous corneal dystrophy have been associated with better results.[6]

In our cases, a mini DM stripping (m-DMES) without graft insertion was performed in the area of persisting focal corneal edema, due to Fuchs' endothelial dystrophy, during cataract surgery. After a transient aggravation, corneal stromal edema gradually decreased resulting in corneal clearance, visual acuity improvement and elimination of foreign body sensation, over a period of four months. The novel part of this technique is the application of ''customized'' descemetorhexis limited in the area of focal corneal edema targeting the most affected part of the DM, and thus sparing the rest of the endothelium, which may still be functional.

We speculated that in contrast to previous reports, our cases were both successful due to the small diameter of DM stripping. All previous reports described area of stripping larger than that of 6.5 mm, whereas in our cases stripping was made at an area of 3 mm and 4 mm diameters. Patients who underwent the procedure were selected having a localized edema while care was taken intraoperatively to strip only the corresponding pathologic DM in order to spare the highest possible quantity of healthy endothelium reserve. Preoperative specular microscopy display showed the boundary of the confluent corneal guttata with the normal endothelial cell structure. Also, histopathologic evaluation revealed relatively small guttata in the peripheral part of the removed DM, whereas in the central part of the removed DM the appearance of the guttata was wider in shape, rather typical of Fuchs' endothelial dystrophy. This type of Fuchs' endothelial dystrophy seems to appear with the clinical manifestation of a localized area of large guttata in the pathologic DM surrounded with rather small guttata with functional endothelium and probably healthy DM. The healthy peripheral endothelial cells could probable repopulate and cover the DM-defect after mini-DM stripping (of the pathologic with large guttae central DM) in the localized edematous corneal area leading to corneal edema restoration in patients with this type of Fuchs' endothelial dystrophy.

This theory is supported in our cases by the results of corneal confocal microscopy, which undoubtedly revealed the presence of endothelial cells covering the previously stripped area. However, the process of edema regression requires at least four months, which could be considered as a drawback of this technique compared to the rather short period of recovery after other EK techniques.

Another factor affecting the efficacy of this technique is the avoidance of scrapping of the posterior stroma during stripping. We hypothesized that a rough posterior stromal surface in the central cornea would undermine patients' quality of vision and also would prevent endothelial cell migration and expansion toward the stripped area. A similar speculation regarding cell migration was made by Arbelaez et al. 8 who observed that despite endothelial repopulation within 4 months of stripped posterior stroma, areas with rough

surface due to surgical manipulation had persistent edema that compromised their results. Smooth posterior surface contributed to the successful results in our cases. Limitations of the study were the short-term follow-up period and the fact that we did not performed any wavefront or Ray tracing measurements in order to evaluate corneal aberrations.

In conclusion, it seems that this new technique of mini DM-stripping (m-DMES) without graft insertion might be applicable to patients with focal corneal edema. This suggests that the remaining endothelium peripheral to the treated area may have the potential to migrate and expand after the removal of the most damaged part of the DM. Small stripping area and smoothness of posterior stromal surface are parameters that may ameliorate results. Further studies are needed to specify technique modifications that may increase its efficacy and also clarify which patients may benefit from this technique.

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None of the authors have any financial support or proprietary interest related to this study.

Conflict of interest

The authors declared that there is no conflict of interest.

References

1. Nanavaty MA, Wang X, Shortt AJ. Endothelial keratoplasty versus penetrating keratoplasty for Fuchs endothelial dystrophy. *Cochrane Database Syst Rev* 2014;**2**:CD008420.
2. Goldich Y, Showail M, Avni-Zauberman N, Perez M, Ulate R, Elbaz U, et al. Contralateral eye comparison of descemet membrane endothelial keratoplasty and descemet stripping automated endothelial keratoplasty. *Am J Ophthalmol* 2015;**159**:155–9.
3. Zafirakis P, Kymionis GD, Grentzelos MA, Livir-Rallatos G. Corneal graft detachment without corneal edema after descemet stripping automated endothelial keratoplasty. *Cornea* 2010;**29**:456–8.
4. Balachandran C, Ham L, Verschoor CA, Ong TS, van der Wees J, Melles GR. Spontaneous corneal clearance despite graft detachment in descemet membrane endothelial keratoplasty. *Am J Ophthalmol* 2009;**148**:227–34.
5. Dirisamer M, Yeh RY, van Dijk K, Ham L, Dapena I, Melles GR. Recipient endothelium may relate to corneal clearance in descemet membrane endothelial transfer. *Am J Ophthalmol* 2012;**154**:290–6.
6. Shah RD, Randleman JB, Grossniklaus HE. Spontaneous corneal clearing after Descemet's stripping without endothelial replacement. *Ophthalmology* 2012;**119**:256–60.
7. Bleyen I, Saelens IE, van Dooren BT, van Rij G. Spontaneous corneal clearing after Descemet's stripping. *Ophthalmology* 2013;**120**:215.
8. Arbelaez JG, Price MO, Price Jr FW. Long-term follow-up and complications of stripping descemet membrane without placement of graft in eyes with Fuchs endothelial dystrophy. *Cornea* 2014;**33**:1295–9.
9. Elhalis H, Azizi B, Jurkunas UV. Fuchs endothelial corneal dystrophy. *Ocul Surf* 2010;**8**:173–84.