The "Two-Flaps" Technique for Descemet Stripping Only

Eyal Cohen, MD, Nizar Din, MD, BSc, FRCOphth, Michael Mimouni, MD, Tanya Trinh, MD, FRANZCO, Larissa Gouvea, MD, Sara AlShaker, MD, FRCSC, Clara C. Chan, MD, FRCSC, FACS, and Allan R. Slomovic, MD, MSc, FRCSC

Purpose: The success of Descemet stripping only (DSO) is optimized by performing a well-centered, accurately sized diameter of descemetorhexis with a smooth curvilinear border. To achieve this success, we describe a repeatable and relatively straightforward technique to optimize this descemetorhexis for DSO.

Methods: The "two-flaps" technique uses the Gorovoy DSO forceps. The technique takes advantage of the flat and smooth surface of the forceps to create the desired 4-mm Descemet stripping with minimal stromal trauma along with a continuous curvilinear descemetorhexis, minimizing the risk of postoperative stromal scarring and extension of the rhexis beyond 4 mm.

Results: This technique has been used successfully in 11 cases performed by 1 surgeon or directly supervised by him. All cases achieved the desired 4-mm circumference without any residual tags or visually significant stromal scarring, with successful clearing of the central cornea and endothelial cells repopulating the central stripped area.

Conclusions: This technique described provides a consistent, reproducible, and relatively trauma-free peeling of Descemet membrane and associated endothelial cells/guttae to optimize the success of DSO.

Key Words: Descemet stripping only, DSO, descemetorhexis without endothelial keratoplasty, DWEK, descemetorhexis, two-flaps technique

(*Cornea* 2021;40:1211–1214)

Fuchs endothelial dystrophy (FED) remains the most common indication for corneal transplantation in the United States.[1,2] Surgical management of FED has undergone multiple iterations over the recent decades from initially performing penetrating keratoplasties to its current state of endothelial keratoplasty, which includes Descemet stripping automated endothelial keratoplasty and Descemet membrane endothelial keratoplasty. The evolution of surgical management of FED has now continued to progress to Descemet stripping only (DSO) in appropriate cases.[3–6]

DSO has gained popularity after observations of endothelial "rejuvenation" in FED despite complete Descemet membrane endothelial keratoplasty graft detachment.[5,7] The proposed mechanism for this phenomenon was thought to be either migration and regeneration of the host endothelium or transfer from the donor endothelium free-floating graft.[8,9] There have also been reports of visual recovery after deliberate or accidental removal of Descemet membrane.[10] Since then, numerous clinical studies have been published that demonstrate that DSO has the potential for treating corneal decompensation and visual symptoms in a subgroup of patients with FED.[5,6,11]

However, there are a number of critical steps in the DSO surgical technique that must be implemented to optimize surgical success. These include optimal Descemet stripping centration, size of descemetorhexis, and achieving a smooth curvilinear descemetorhexis edge.[3] Depending on the case series, current success rates for DSO range between 63% and 100%.[5,6,11–14] Currently, there is no a step-by-step description of a safe and reproducible technique for the removal of Descemet membrane in the literature during DSO.

We describe our current technique, the "two-flaps" technique, which we feel allows for accurate, consistent, and minimally disruptive peeling of Descemet membrane.

MATERIAL AND METHODS

"Two-Flaps" Technique

A 79-year-old woman with central 5-mm bilateral symptomatic guttata and cataracts underwent left combined phacoemulsification, intraocular lens implantation and DSO surgery. Best-corrected visual acuity preoperatively was Snellen 20/40, with a central endothelial cell count of 430 cells/mm^2 and central corneal thickness of 546 μm.

A temporal approach was used with the procedure being performed using topical tetracaine 1% and 0.4 mL intracameral lidocaine 1%. An ink-marked caliper set at 4.0 mm was applied to the dry surface of the cornea with 8 points applied centrally over the nondilated pupil (Fig. 1A). Next, 0.4 mL of intracameral phenylephrine 2.5%, diluted in 1:3 ratio with basic salt solution and 0.4 mL of 1% lidocaine, was given to promote pupil dilation and provide additional

Received for publication January 2, 2021; revision received February 20, 2021; accepted February 28, 2021. Published online ahead of print May 20, 2021.
From the Department of Ophthalmology and Vision Sciences, University of Toronto, Toronto, Canada.
The authors have no funding or conflicts of interest to disclose.
Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.corneajrnl.com).
Correspondence: Eyal Cohen, MD, Department of Ophthalmology and Vision Sciences, Toronto Western Hospital, University of Toronto, 399 Bathurst St, 6th Floor East Wing, Reception 1, Toronto, ON M5T 2S8, Canada (e-mail: coheneyal123@gmail.com).

anesthesia, respectively. A standard phacoemulsification technique was performed with a 5.5-mm continuous curvilinear capsulorrhexis and in the bag intraocular lens placement. Cohesive viscoelastic was left remaining in the anterior chamber to maintain stability for performing the descemetorhexis.

The operative microscope was calibrated to high magnification focusing on Descemet membrane. Holding the Gorovoy forceps (Moria, France) closed and taking advantage of its wide and flat surface area, a small nick in Descemet membrane was made using the friction of the metal against Descemet membrane (Fig. 1B). This nick creation was first performed in an anticlockwise fashion and once formed, the Gorovoy forceps was then opened and grasped to encourage further guided peeling along the preplaced marking points, creating a 2 clock hours flap (Fig. 1C). With the opening of Descemet already created, the Gorovoy forceps are then used to peel in a clockwise manner for another 2 clock hours (Fig. 1D) as follows: with the newly formed 4 clock hour Descemet crescent-shaped flap opening, Descemet was grasped in the middle of this opening and peeled toward the center of the 4-mm circumference up to the halfway point (Fig. 1E). The Gorovoy forceps was then used to perform a continuous curvilinear descemetorhexis, keeping within the 8-point marker (Fig. 1F). Once this was completed, the Descemet tissue was removed from the eye through the main wound (Fig. 1G). A well-centered descemetorhexis on visual axis was performed (Fig. 1H). Thorough irrigation and aspiration were performed before hydrating the main wound (see Supplemental Video, Supplemental Digital Content 1, http://links.lww.com/ICO/B201).

The patient was then commenced on postoperative 0.4% ripasudil drops (Glanatec; Kowa Pharmaceuticals, Japan) 4 times a day for 2 months (it should be noted that ripasudil drops are being used as an off-label treatment for this indication, and it is now under further investigation for this indication), 0.1% dexamethasone sodium phosphate drops (Maxidex; Alcon Labs Inc, Fort Worth, TX) 4 times a day tapering by 1 drop each week for 1 month, and 0.5% moxifloxacin hydrochloride drops (Vigamox; Alcon Canada Inc, Mississauga, CA) 4 times a day for a week.

RESULTS

The described patient achieved complete corneal clearance within 4.5 weeks postoperatively. At 3 months, central corneal thickness was 520 μm and central endothelial cells measured 808 cells/mm2. Best-corrected visual acuity was 20/20, and all preoperative visual symptoms resolved.

This technique has been used successfully in 11 cases performed by 1 surgeon (A.R.S.) or by corneal fellows directly supervised by him. All cases achieved the desired

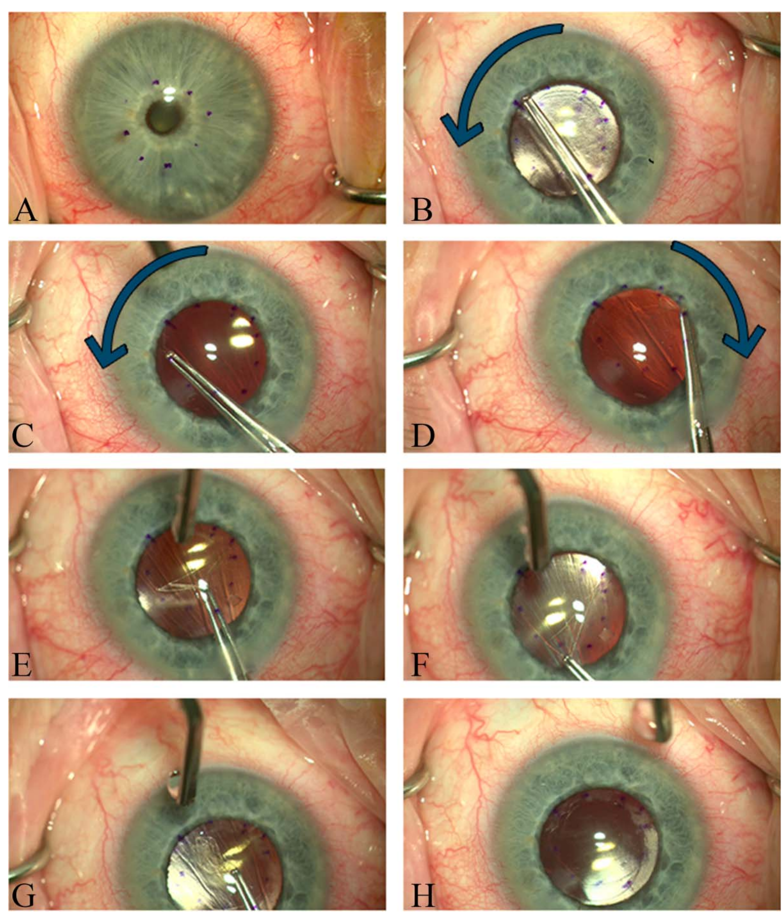

Figure 1. DSO, the two-flaps technique: (A) 8 points are marked with a caliper at a set circumference of 4 mm over a nondilated pupil. B, With closed Gorovoy forceps, the first flap is gently elevated in an anticlockwise fashion. C, The elevated flap is then picked up and encouraged to peel for a further 2 clock hours (anticlockwise). D, A second flap is created in a clockwise direction for another 2 clock hours. E, Descemet membrane is then grasped in the middle of the crescent-shaped opening, that has been created, peeling into the central axis toward the halfway point. F, The descemetorhexis is then completed in a curvilinear manner according to the preplaced 8-point marks. G, A single sheet of peeled Descemet is removed through the main wound. H, A 4-mm descemetorhexis is complete with underlying 5.5 mm capsulorhexis. (The full color version of this figure is available at www.corneajrnl.com.)

4-mm circumference without any residual tags or central corneal scars (Fig. 2); 1 patient developed a faint stromal scar in the area where Descemet was initially opened, which was not visually significant and tended to fade with time. All eyes completed at least 4 months of postoperative follow-up (mean follow-up 9.9 ± 5.9 mo; 4–23 mo). The mean patient age was 66 ± 9 years. All eyes achieved corneal clearance with an average time for clearance being 7.45 ± 2.5 weeks. Preoperative endothelial cell count was successfully measured for 3 patients with a mean of 485; for the rest, the endothelial cell count was undetectable preoperatively. Mean endothelial cell count postoperatively was 882 ± 184. Mean central corneal thickness preoperatively and postoperatively were 645 ± 106 and 573 ± 58 μm, respectively. Improvement in visual acuity was achieved in all eyes with overall improvement increasing from a median of 0.34 to 0.21 LogMAR, with subjective improvement in quality of vision.

DISCUSSION

The DSO surgical technique has evolved since its first inception, when Bleyen et al reported an 8-mm descemetorhexis for FED. However, this group only achieved successful corneal clearance in 1 of 8 cases. Since then, numerous cases have demonstrated that confining the descemetorhexis to the central 4 mm leads to a successful outcome.[4–6,11,12,14] Despite corneal clearance, patients can develop ghosting and irregular astigmatism postoperatively.[6] Furthermore, postoperative analysis of the cornea shows an increase in central posterior float that is localized to the site of Descemet stripping. This confirms the need for a descemetorhexis that is centered over the visual axis which can be achieved through measuring and marking the 4-mm Descemetorhexis zone over the nondilated pupil.[13]

Peeling of Descemet membrane rather than scoring with inadvertent excessive pressure into the deeper stroma is important for surgical success. It has been observed that a postoperative deep stromal scar usually corresponds to the location of where the scoring has taken place.[3] The theory, therefore, is that the surgical trauma induced by the reverse Sinskey hook (Storz Ophthalmics, Germany) to score the endothelium/Descemet membrane complex initiates an inflammatory proscarring response, leading to stromal keratocyte activation, proliferation, fibrosis, and deep stromal scarring.[3] Furthermore, specular microscopic analysis has shown the appearance of a stromal trench at the site of scoring reference. This can theoretically act as a barrier for endothelial cell migration from the periphery into the central peeled zone.[3] The technique we describe reduces the complications associated with the use of a reverse Sinskey Hook. Using the smooth, nonsharp surface of the Gorovoy forceps for creating the first nick in Descemet membrane which then extends, by peeling only, to 2 flaps of 2 clock hours for each side reduces trauma to the underlying stroma and thereby reduces the risks of stromal scarring and stromal trench formation.

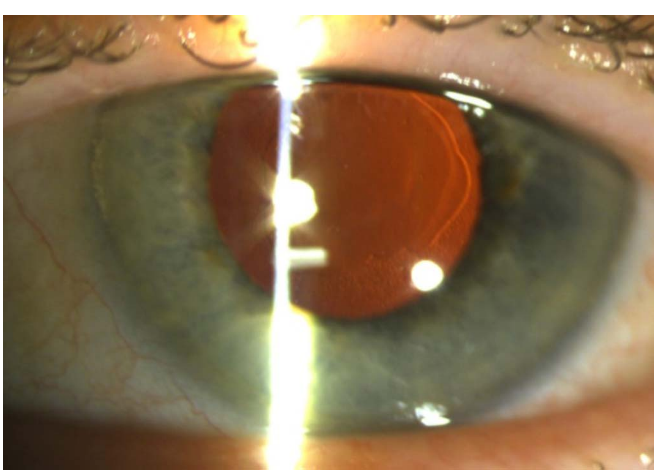

Figure 2. A slit lamp photograph showing descemetorhexis. A slit-lamp photograph using a red reflex to demonstrate the consistently round nature of the rhexis and lack of scarring. (The full color version of this figure is available at www.corneajrnl.com.)

Finally, one of the surgical techniques proposed for how to initiate a descemetorrhexis involves a limited 2 clock hour scoring of the Descemet membrane-endothelial complex, followed by peeling of the membrane. The difficulty with this technique is that unlike the anterior capsule, the Descemet membrane possesses low elastic properties and if using only one small edge it is often difficult to anticipate the direction of the flap movement. This can result in the need to rescore and grab at a new edge, which can lead to an increased risk of stromal scarring. Our "two-flaps" technique provides a broad edge of Descemet membrane to grip with initial 4 clock hours opening in Descemet membrane, which enhances peeling of a single continuous curvilinear sheet in a more controlled and accurate manner to the desired diameter size. Akin to a capsulorhexis, the surgeon has better control to manipulate the Descemet tear at the appropriate angle to ensure no tags or Descemet membrane remnants are left behind. Furthermore, with this technique, the Descemet membrane is less likely to run outward and extend beyond the 4-mm central zone.

In conclusions, the "two-flap" technique we describe provides a safe, reproducible, and consistent means of performing a 4-mm descemetorhexis, which limits the trauma and possible subsequent scarring thus optimizing the success of DSO.

ACKNOWLEDGMENTS

The authors acknowledge John Kim for his contribution in the editing of the clinical photographs.

REFERENCES

1. Tong CM, Melles GRJ. Où devrait se diriger la kératoplastie endothéliale: de la DSAEK à la DMEK au DMET? *Can J Ophthalmol*. 2012;47:197–200.
2. Ple-Plakon PA, Shtein RM. Trends in corneal transplantation: indications and techniques. *Curr Opin Ophthalmol*. 2014;25:300–305.
3. Garcerant D, Hirnschall N, Toalster N, et al. Descemet's stripping without endothelial keratoplasty. *Curr Opin Ophthalmol*. 2019;30:275–285.
4. Davies E, Jurkunas U, Pineda R. Predictive factors for corneal clearance after descemetorhexis without endothelial keratoplasty. *Cornea*. 2018;37:137–140.

5. Borkar DS, Veldman P, Colby KA. Treatment of Fuchs endothelial dystrophy by Descemet stripping without endothelial keratoplasty. *Cornea*. 2016;35:1267–1273.
6. Iovieno A, Neri A, Soldani AM, et al. Descemetorhexis without graft placement for the treatment of Fuchs endothelial dystrophy: preliminary results and review of the literature. *Cornea*. 2017;36: 637–641.
7. Dirisamer M, Yeh RY, Van Dijk K, et al. Recipient endothelium may relate to corneal clearance in Descemet membrane endothelial transfer. *Am J Ophthalmol*. 2012;154:290–296.e1.
8. Dirisamer M, Ham L, Dapena I, et al. Descemet membrane endothelial transfer: "Free-floating" donor Descemet implantation as a potential alternative to keratoplasty. *Cornea*. 2012;31:194–197.
9. Lam FC, Bruinsma M, Melles GR. Descemet membrane endothelial transfer. *Curr Opin Ophthalmol*. 2014;25:353–357.
10. Koenig SB. Planned descemetorhexis without endothelial keratoplasty in eyes with Fuchs corneal endothelial dystrophy. *Cornea*. 2015;34:1149–1151.
11. Moloney G, Petsoglou C, Ball M, et al. Descemetorhexis without grafting for Fuchs endothelial dystrophy-supplementation with topical ripasudil. *Cornea*. 2017;36:642–648.
12. Macsai MS, Shiloach M. Use of topical rho kinase inhibitors in the treatment of Fuchs dystrophy after Descemet stripping only. *Cornea*. 2019;38:529–534.
13. Davies E, Pineda R. Corneal tomography changes and refractive outcomes after Descemet stripping without endothelial keratoplasty. *Cornea*. 2019;38:817–819.
14. Huang MJ, Kane S, Dhaliwal DK. Descemetorhexis without endothelial keratoplasty versus DMEK for treatment of Fuchs endothelial corneal dystrophy. *Cornea*. 2018;37:1479–1483.