Risk Factors for Repeat Descemet Membrane Endothelial Keratoplasty Graft Failure

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• PURPOSE: To evaluate repeat Descemet membrane endothelial keratoplasty (re-DMEK) success rates and to identify risk factors for re-DMEK failure.
• DESIGN: Retrospective case series.
• METHODS: *Settings*: Institutional. *Patients and interventions*: A chart review was performed, including all eyes with primary DMEK failure that underwent re-DMEK between 2013 and 2019 at the Toronto Western Hospital and the Kensington Eye Institute (Toronto, Ontario, Canada) and had at least 6 months of follow-up. *Main outcome measure*: Predicting factors for re-DMEK outcome.
• RESULTS: Of 590 consecutive DMEK surgeries, 40 eyes (6.7%) were identified for having a secondary DMEK surgery after primary DMEK failure. Etiologies for primary DMEK were Fuchs endothelial corneal dystrophy (32.5%), pseudophakic bullous keratopathy (35%), previous failed graft (27.5%), and other indications (5%). Fifty-five percent of the cohort were categorized as having a complicated anterior segment including 11 eyes with previous glaucoma surgery, 7 eyes post–penetrating keratoplasty, 4 eyes post–Descemet stripping automated endothelial keratoplasty, 3 eyes peripheral anterior synechia, 3 eyes previous pars plana vitrectomy, 2 eyes aphakia, and 1 eye each with aniridia, anterior chamber intraocular lens, and iris-fixated intraocular lens. Re-DMEK failure was documented in 12 eyes (30%) of the entire cohort. The risk factor for re-DMEK failure was the presence of a complicated anterior segment ($P = .01$, odds ratio = 17.0 [95% confidence interval: 1.92-150.85]), with 50% re-DMEK failure rate in this subgroup.
• CONCLUSION: Re-DMEK is a viable option for cases of primary DMEK failure, especially for eyes with Fuchs endothelial corneal dystrophy as the indication for primary DMEK without other ocular morbidities; however, eyes categorized with a complicated anterior segment had high re-DMEK failure rates.</ABSTRACT> (Am J Ophthalmol 2021;226: 165–171. © 2021 Elsevier Inc. All rights reserved.)

In recent years, Descemet membrane endothelial keratoplasty (DMEK) has gained popularity for the treatment of corneal endothelial dysfunction. Compared with Descemet stripping automated endothelial keratoplasty (DSAEK), DMEK possesses clear advantages by promoting faster visual recovery, better clinical outcomes, and reduced rejection rates.[1-5] However, DMEK can be more challenging to perform with a long learning curve; it is also more prone to partial or complete detachment and delayed or incomplete corneal clearing.[6] Primary graft failure (PGF) leading to incomplete visual rehabilitation is estimated to occur in 0%-9% of DMEK cases.[7]

These complications are even more pronounced when surgery is performed on complicated eyes such as with the presence of previous glaucoma surgery, post–penetrating keratoplasty (PKP), or vitrectomized eyes with higher primary failure rates.[8-10] Moreover, a secondary graft failure (SGF) rate of 6% in 10 years has been reported among patients with Fuchs dystrophy.[5] Recently, our group reported a 4-year survival rate of 27% after DMEK in the presence of previous glaucoma surgery.

In cases of PGF or SGF, a repeat corneal transplant is indicated. Previously published studies evaluating the functional outcome of repeat DMEK (re-DMEK) showed a comparable outcome to primary DMEK transplant among Fuchs patients,[11-14] but there is a scarcity of data regarding the success rates and risk factors for failure of re-DMEK in complicated eyes (eg, post-vitrectomy, previous glaucoma surgery and previous PKP, or DSAEK). Therefore, the aim of the current study was to evaluate re-DMEK success rates and functional outcomes and to identify the risk factors for re-DMEK failure among patients with failed primary DMEK.

METHODS

This retrospective institutional observational study was conducted in compliance with the tenets of the Declaration

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of Helsinki and received Research Ethics Board approval from University Health Network (Toronto Western Hospital, Toronto, Canada).

• **STUDY PARTICIPANTS:** A retrospective chart review was performed, including all eyes with primary DMEK failure that underwent re-DMEK between 2013 and 2019 at the Toronto Western Hospital and the Kensington Eye Institute (Toronto, Ontario, Canada) and had at least 6 months of follow-up. All primary DMEK procedures were performed by a single experienced corneal surgeon (D.S.R.) or were directly supervised by him; the entire re-DMEK procedures were performed by the corneal expert (D.S.R.).

• **DATA COLLECTION:** The data collected in this study included demographic characteristics, best spectacle-corrected visual acuity, intraoperative and postoperative complications, corneal donor characteristics, endothelial cell loss (ECL) rate using a noncontact specular microscopy (Robo, KSS 300; Konan Medical, Hyogo, Japan), and re-DMEK failure rate.

• **DONOR PREPARATION:** All donor tissues used for primary and re-DMEK were stored in corneal storage solution (Optisol; Bausch & Lomb, Rochester, New York, USA) and received from the Eye Bank of Canada, Ontario division. Graft endothelial cell density (ECD, cells/mm^2) was measured by specular microscopy (CellCheck EB-10; Kenon Medical, California, USA).

DMEK graft preparation was performed according to the modified Melles technique,[15] and the donor graft was marked using an "F" letter through a stromal window.[16]

• **REPEAT DMEK SURGICAL TECHNIQUE:** Our DMEK technique has been described previously,[17] and repeat DMEK was performed in a similar fashion with minor modifications. Briefly, after topical application of tetracaine hydrochloride 1.0%, all patients received a subtenon block consisting of a 50:50 mix of lidocaine 2% and bupivacaine 0.5%, 2 limbal paracenteses were performed at 2 and 10 o'clock, and an anterior chamber maintainer was inserted inferotemporally into the anterior chamber. In previously vitrectomized eyes, a pars plana infusion was used to better control anterior chamber depth.[8] A temporal 2.4 mm clear corneal incision was performed (or reopened). Instead of performing a descemetorhexis, the primary DMEK graft was removed from the recipient posterior stroma with a reverse Sinskey hook (D.O.R.C., Zuidland, the Netherlands) under balanced salt solution infusion. VisionBlue (D.O.R.C., Zuidland, the Netherlands) was used to assist in identification of remnant Descemet tags requiring removal. The DMEK graft was loaded into either a glass pipet (Geuder AG, Heidelberg, Germany) or an intraocular lens (IOL) injector (Monarch D; Alcon Labs Inc, Fort Worth, Texas, USA) and injected into the anterior chamber through the 2.4 mm incision. The anterior chamber infusion was controlled with a foot pedal to stabilize the anterior chamber and was removed after injection of the new DMEK tissue. The graft was then unfolded and positioned using a tapping technique,[18] and the anterior chamber was then filled with air or 20% sulfur hexachloride (SF6). The decision of using SF6 instead of air was taken according to surgeon discretion. Next, balanced salt solution was injected into the anterior chamber to adjust the air bubble size up to a diameter slightly larger than that of the graft. No peripheral iridectomy was performed.[19] Cyclopentolate hydrochloride 1% (MINIMS Cyc 1.0; Chauvin Pharmaceuticals Ltd, UK) and phenylephrine hydrochloride 2.5% (MINIMS PHNL 2.5; Chauvin Pharmaceuticals Ltd, UK) were instilled for pupil dilation to prevent pupillary block.

• **POSTOPERATIVE MANAGEMENT:** After at least 2 hours of supine positioning, patients were assessed at the slit lamp. In cases of full air fill in the anterior chamber, a small amount of air was released from the inferior paracenteses to allow the inferior pupil margin to be clear from the air bubble. Patients were then instructed to maintain supine positioning at home until the next morning. All patients were examined 1 day after surgery and started on 0.1% dexamethasone sodium phosphate and 0.3% tobramycin antibiotic (Tobradex; Alcon, Mississauga, Ontario, Canada) eye drops 4 times daily for 1 week followed by discontinuation of the antibiotic-steroid drops and initiation of 0.1% dexamethasone sodium phosphate (Maxidex; Alcon Labs Inc) eye drops 4 times daily; drops were tapered down over a 4-month period and continued once daily thereafter for a prolonged period of time. Patients were re-examined at 1 week, 1 month, quarterly for the first postoperative year, semiannually for the second postoperative year, and annually thereafter.

Rebubbling was performed if graft detachment involved more than one-third of the graft.[20]

PGF was defined as a fully detached graft or a partially detached graft with central corneal edema, which did not improve after rebubbling or when the cornea did not clear postoperatively although the graft was attached. SGF was defined as corneal decompensation after an initially functional DMEK graft.[21] Endothelial graft rejection was defined as the presence of inflammation as evidenced by anterior chamber cells, keratic precipitates or endothelial rejection line, and/or the presence of corneal edema with conjunctival injection and symptoms of pain or light sensitivity.[2,22]

• **STUDY OUTCOMES:** Primary outcomes included re-DMEK failure rate and type of graft failure, and secondary outcomes included rate of intraoperative and postoperative complications, graft detachment/rebubbling, best-corrected visual acuity (BCVA), and ECL.

Successful re-DMEK was defined as a cornea that remained sufficiently clear after transplantation to an extent

that further corneal transplantation was deemed unnecessary.

• **STATISTICAL ANALYSIS:** Data were recorded in Microsoft Excel (2019) and analyzed using the Minitab Software, version 19 (Minitab Inc, State College, Pennsylvania, USA). For the analysis of continuous data, the Student *t* test was used. For the analysis of categorical variables, the χ^2 test or the Fisher exact test was used wherever appropriate. Binary logistic regression (stepwise) was performed to identify factors associated with re-DMEK failure. For this purpose, only variables that were significant or close to significant ($P < .10$) in the univariate analysis were included. In all analyses, a 2-sided *P* value <.05 was considered statistically significant. All presented means are accompanied by their respective standard deviations.

RESULTS

Overall, of 590 consecutive DMEK surgeries performed throughout the study period, 40 eyes (6.7%) of 40 patients underwent a re-DMEK procedure; all of them had at least 6 months of follow-up and were included in the study. The cohort had a mean follow-up of 39.7 (19.8) months. The mean age was 70 ± 12 years, and 58% (n = 23) were of female gender. Etiology for primary DMEK was 13 eyes (32.5%) with Fuchs endothelial corneal dystrophy (FECD), 14 eyes (35%) with pseudophakic bullous keratopathy (PBK), 11 eyes (27.5%) for previous failed graft (7 post-PKP and 4 post-DSAEK), and 2 eyes (5%) for other indications (1 Herpes simplex virus keratouveitis and 1 aphakic bullous keratopathy). On the primary DMEK procedure, 22 eyes (55%) were categorized as a complicated anterior segment, which accounts for any ocular comorbidities that could potentially make the DMEK procedure more challenging, including 11 eyes (27.5%) with previous glaucoma surgery, 7 eyes (17.5%) post-PKP, 4 eyes (10%) post-DSAEK, 3 eyes (7.5%) with peripheral anterior synechia, 3 eyes (7.5%) with previous pars plana vitrectomy, 2 eyes (5%) with aphakia, 1 eye with aniridia, 1 eye with an anterior chamber IOL, and 1 eye with an iris fixation IOL. Overall, 8 eyes (20%) had more than 1 risk factor categorizing them as a complicated anterior segment. Etiologies for primary DMEK failure were PGF in 23 eyes (57.5%), SGF in 13 eyes (32.5%), and immune rejection in 4 eyes (10%). The median duration between primary DMEK and re-DMEK was 4.2 (range, 0.4-63.6) months. Table 1 summarizes the demographics and primary DMEK data.

TABLE 1. Patients Demographics and Primary Descemet Membrane Endothelial Keratoplasty Data

Patient age, y (SD)	70 (12)
Female gender, n (%)	23 (57.5)
Laterality: left eyes (%)	18 (45)
Etiology for primary DMEK, n (%)	
FECD	13 (32.5)
PBK	14 (35)
Previous failed graft	
PKP	7 (17.5)
DSAEK	4 (10)
Other	2 (5)
Lens status at the time of primary DMEK surgery, n (%)	
Phakic	14 (35)
Pseudophakic	24 (60)
Aphakic	2 (5)
Primary DMEK procedure	
DMEK as single procedure, n (%)	20 (50)
DMEK combined with phacoemulsification, n (%)	14 (35)
DMEK combined with other procedure, n (%)	6 (15)
Complicated anterior segment[a], n (%)	22 (55)
BCVA before primary DMEK, LogMAR (SD)	1.2 (0.9)
Etiology for primary DMEK failure, n (%)	
PGF	23 (57.5)
SGF	13 (32.5)
Immune rejection	4 (10)
BCVA before re-DMEK, LogMAR (SD)	1.6 (0.6)

BCVA = best-corrected visual acuity, DMEK = Descemet membrane endothelial keratoplasty, DSAEK = Descemet stripping automated endothelial keratoplasty, FECD = Fuchs endothelial corneal dystrophy, LogMAR = logarithm of the minimum angle of resolution, PBK = pseudophakic bullous keratopathy, PGF = primary graft failure, PKP = penetration keratoplasty, SGF = secondary graft failure.

[a]Post pars plana vitrectomy, post glaucoma surgery (trabeculectomy, glaucoma drainage device), post previous corneal graft (DSAEK, PKP), presence of peripheral anterior synechia, aphakia, aniridia, anterior chamber intraocular lens, iris-fixated intraocular lens.

• **DONOR GRAFT PARAMETERS:** For the primary DMEK graft, the mean donor age was 64.8 (6.9) years, the mean ECD was 2,745 (227) cells/mm^2, the mean death-to-implantation time was 7.0 (1.9) days, and the mean graft diameter was 8.35 (0.2) mm (range, 8.0-9.0 mm). For the re-DMEK graft, the mean donor age was 65.4 (5.6) years, the mean ECD was 2,765 (229) cells/mm^2, the mean death-to-implantation time was 7.2 (1.8) days, and the mean graft diameter was 8.24 (0.3) mm (range, 7.75-9.00 mm). Differences in donor data (age, ECD, death-to-implantation time, and graft diameter) between the primary DMEK grafts and re-DMEK grafts were not statistically significant ($P = .613$, .704, .395, and .055, respectively).

• **RE-DMEK POSTOPERATIVE COMPLICATIONS:** Six eyes (15%) had graft detachment ≥30% of graft area, 2 of which had a complete detachment. Two eyes (5%) underwent a single rebubbling, and 2 eyes underwent 2 rebubbling procedures. Table 2 summarizes all postoperative complications.

TABLE 2. Re-DMEK Postoperative Complications

Complication	No.
Graft detachment	
One-third or less of graft surface area	8
More than one-third of graft area	6
Chronic angle closure glaucoma requiring GDD	1
IOP elevation[a]	1
Hyphema and vitreous hemorrhage	1
Cystoid macular edema	2
Corneal ulcer	1

GDD = glaucoma drainage device, IOP = intraocular pressure, re-DMEK = repeat Descemet membrane endothelial keratoplasty.
[a]Steroid responder.

TABLE 3. Risk Factors for re-DMEK Failure

	Success	Failure	*P* value
Age, mean	72.0	68.3	.50
Sex, female	16	7	.94
Indication for primary DMEK			
FECD	13	0	.004
PBK	10	4	0.88
Previous failed graft	4	7	.004
Etiology for primary DMEK failure			
PGF	18	5	.18
SGF	8	5	.41
Immune rejection	2	2	.35
Complicated anterior segment	11	11	.002
Prior glaucoma surgery	5	6	.03
Prior PKP	3	4	.08
Prior DSAEK	1	3	.11
Prior PPV	2	1	–
PAS	1	2	–
Intraoperative complication noted	1	2	.21
Use of SF6	4	3	.41
Bubble size[a], mean (%)	44.2	40.6	.51
Rebubble needed	1	3	.03

DSAEK = Descemet stripping automated endothelial keratoplasty, FECD = Fuchs endothelial corneal dystrophy, PAS = posterior peripheral synechia, PBK = pseudophakic bullous keratopathy, PGF = primary graft failure, PKP = penetrating keratoplasty, PPV = pars plana vitrectomy, re-DMEK = repeat Descemet membrane endothelial keratoplasty, SGF = secondary graft failure.
[a]Bubble size at post operation day 1, for primary failure only.

• **FAILURE OF RE-DMEK GRAFT:** Re-DMEK failure was documented in 12 eyes (30%); etiologies for re-DMEK failure were PGF in 8 eyes and SGF in 4 eyes. No immune rejection was observed for re-DMEK. The median duration for re-DMEK failure was 2.7 (range, 0.2-25) months. Of the ones that failed the re-DMEK, 9 (75%) underwent a third DMEK procedure and 1 (8.3%) underwent subsequent PKP. Among them, 2 eyes that had a third DMEK required a fourth corneal transplant.

• **RISK FACTORS FOR RE-DMEK FAILURE:** Table 3 depicts a comparison between eyes where the re-DMEK was successful vs those that failed. Briefly, FECD was a protective factor with no cases of re-DMEK failure ($P = .004$). Eyes with failed previous graft as the indication for primary DMEK were at higher risk for re-DMEK failure ($P = .04$). The complicated anterior segment was also found to be a risk factor for re-DMEK failure ($P = .002$), previous glaucoma surgery ($P = .03$), and the need for rebubble ($P = .03$). All other parameters (age, sex, PBK as the indication for primary DMEK, etiology for primary DMEK failure, surgeon level of experience at primary DMEK, intraoperative complications, the use of SF6, and bubble size at day 1 after re-DMEK) did not yield significant results. In binary logistic regression analysis, the only factor that remained a significant predictor of re-DMEK failure was whether or not there was a complex anterior segment ($P = .01$, odds ratio = 17.0 [95% confidence interval: 1.92-150.85]).

• **VISUAL ACUITY AND ENDOTHELIAL CELL DENSITY OUTCOMES:** Among the 32 re-DMEK eyes that did not experience a PGF, the mean preoperative BCVA was 1.65 (0.59) logarithm of the minimum angle of resolution (Snellen equivalent 20/900), and the mean postoperative BCVA at 6 months, 12 months, and 24 months were 0.60 (0.51), 0.60 (0.48), and 0.37 (0.38) logarithm of the minimum angle of resolution (Snellen equivalent 20/80, 20/80, and 20/40), respectively. The mean ECD of the donor graft was 2,775 (222) cells/mm^2; postoperatively, ECD and % ECL at 6 months, 12 months, and 24 months were [1,885(646), 31.9%], [1,622(670), 39.0%], and [1,511(633), 43.5%], respectively. Table 4 summarizes visual acuity and ECD outcomes.

DISCUSSION

The aim of the current study was to evaluate the failure rates of re-DMEK after failed primary DMEK and to identify risk factors for re-DMEK failure. In our study, re-DMEK failure rate was 30%. Previous studies evaluating re-DMEK after failed primary DMEK showed varying results ranging between 0% and 21% for re-DMEK failure.[7,11-13] In the current study, FECD as the original indication for primary DMEK was a protective factor, whereas a complicated anterior segment was a significant risk factor for re-DMEK failure.

The major difference between the current study and previous re-DMEK studies is the indications for primary DMEK. Price and associates,[13] Agha and associates,[11] and

TABLE 4. Visual Acuity and Endothelial Cell Density Outcome for re-DMEK

Variable	Results
Visual acuity (LogMAR), mean (SD)	
Preoperative, n = 32	1.65 (±0.59)
Postoperative at 6 mo, n = 28	0.60 (±0.51)[a]
Postoperative at 12 mo, n = 21	0.60 (±0.48)[a]
Postoperative at 24 mo, n = 11	0.37 (±0.38)[a]
Endothelial cell density (cells/mm^2)	
Donor ECD	2,775 (±222)
Postoperative at 6 mo	1,885 (±646)
Endothelial cell loss (%)	31.9
Postoperative at 12 mo	1,622 (±670)
Endothelial cell loss (%)	39.0
Postoperative at 24 mo	1,511 (±633)
Endothelial cell loss (%)	43.5

ECD = endothelial cell density, LogMAR = logarithm of the minimum angle of resolution, re-DMEK = repeat Descemet membrane endothelial keratoplasty.

[a]*P* value <.001.

Moura-Coelho and associates[12] had 93%, 85%, and 80% of the eyes, respectively, with FECD as the indication for primary DMEK, in comparison with the current study, which had only 32.5% of the eyes with FECD as the indication for primary DMEK; the remaining were PBK (35%) and previous failed graft (27%), either PKP or DSAEK. We speculate that these more diverse and complicated eyes contributed to higher re-DMEK failure rates. This is supported by the fact that in the subgroup analysis of the FECD eyes, there were no re-DMEK failures. Interestingly, PBK as an indication for primary DMEK was neither found to be a protective factor for success nor a risk factor for failure, which probably keeps these eyes as good candidates for the re-DMEK procedure with 71% success rate for re-DMEK.

Previous failed graft, as indication for transplant, found to be a significant risk factor for re-DMEK failure ($P = .004$), interestingly, previous PKP or DSAEK alone showed only a trend but did not reach significant results ($P = .11$ and $P = .08$, respectively), the author speculate that due to the low number of eyes in each group we were under power to show significant results but combining them to 1 group "previous failed graft" yield significant results and clarified the importance of these risk factors.

Donor graft parameters did not differ between primary DMEK grafts and re-DMEK grafts in this study. For getting a better understanding of whether donor graft parameters could have an effect on primary DMEK failure in our study, we performed a secondary analysis comparing donor graft parameters between our first 250 DMEK data and the primary failed DMEKs in this study. Results were nonsignificant for all donor parameters with the mean donor age of 66.48 and 64.88 years, respectively ($P = .178$), the mean donor size of 8.45 and 8.35 mm, respectively ($P = .256$), and the mean ECD of 2,758 and 2,745 cells/mm^2, respectively ($P = .756$). Results show that donor graft parameters did not play a role in primary DMEK failure in our study.

In the current study, 55% of the eyes were categorized as having a complicated anterior segment, which can increase the likelihood of intraoperative complications, graft detachment, and secondary failure.[9,23] In this study, the complicated anterior segment subgroup had 50% re-DMEK failure, of them, 50% due to PGF and graft detachment. This finding can be explained by the complicated anatomy or behavior of the anterior segment in this subgroup, which makes them more prone to re-DMEK failure and raises the question whether in the setting of a complicated anterior segment we should recommend the re-DMEK procedure or may consider DSAEK as an alternative transplant procedure. Further studies need to be performed for answering this question.

Secondary re-DMEK failure was noted in 4 eyes in the study cohort. The mean time for failure was 19.2 (±5.9) months; all were categorized as a complicated anterior segment. Three of them had previous glaucoma drainage device surgery, and 1 was post–failed DSAEK. Birbal and associates[24] described 2-year outcomes of DMEK in eyes with previous glaucoma surgery, showing the survival probability of 67% at 2 years. Pasari and associates[25] depict a similar survival drop seen in DMEK performed under a failed PKP in eyes with previous glaucoma surgery, where 3-year graft survival rates were 39%. Our study group recently published the 4-year survival rate of DMEK performed in eyes with previous glaucoma surgery, which was down to 27% by the fourth year.[23]

Etiologies for primary DMEK failure were not found to be a risk factor for re-DMEK failure. Special concern was raised regarding immune rejection. Baydoun and associates[14] published their experience on the re-DMEK procedure; in their cohort, 1 patient who had immune graft rejection of the first DMEK developed 2 episodes of immune rejection after the second DMEK, which were managed successfully with topical steroids. Moura-Coelho and associates[12] in their study had 2 eyes (14%) that developed graft rejection after re-DMEK; one of them had PGF due to immune rejection. In our study, none of the re-DMEK failure were secondary to immune rejection as a cause for re-DMEK failure, 4 eyes that had primary DMEK failure caused by immune rejection, after re-DMEK procedure, 2 of them maintained a clear graft up to 20 months follow-up, and 2 had detached after the second procedure requiring a third DMEK surgery which maintained clear up to 12 months postoperatively with no episodes of rejection.

The use of SF6 compared with air as anterior chamber tamponade is known for decreasing postoperative graft detachment rates and the need for rebubbling.[26,27] In the current study, 7 cases of re-DMEK had SF6 as a tamponade gas; 4 of them had been categorized as having a complicated anterior segment (2 with previous PKP, 1 with pre-

vious PKP and tube, and 1 with dropped IOL that had combined surgery with pars plana vitrectomy, iris fixation IOL, and DMEK). The remaining 3 cases were categorized as regular cases. All cases that used SF6 had no graft detachment postoperatively; 3 cases that failed with re-DMEK were among the complicated anterior segment group. Reasons for graft failure were secondary failure 11 months post operation (PKP with tube), primary failure - graft did not clear (2 cases with previous PKP). SF6 was not found to be a protective factor for success compared with air ($P = .41$), nor did bubble size at day 1 after surgery ($P = .51$).

There are several limitations to this study, including its retrospective nature, its small sample size, and the wide heterogeneity of the preoperative diagnosis. However, it is the second largest study evaluating re-DMEK results and the first to assess factors that might be associated with graft failure and success. The wide heterogeneity has its disadvantages that mainly concern the inability to generalize our results for the entire study cohort. Nevertheless, because this study had more complicated eyes with diverse history, we succeeded to get some insight regarding success rate in much more complicated eyes, which could not be reached and was never described before. Future studies should compare DSAEK vs re-DMEK in these complicated eyes.

In conclusion, re-DMEK is a viable option for cases of primary DMEK failure, especially for eyes with FECD as the indication for primary DMEK without other ocular morbidities; however, eyes categorized with a complicated anterior segment have a high re-DMEK failure rate. In this setting, we should discuss with the patient of a higher failure rate up to 50% of the cases according to the current study.

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