Descemet Stripping Automated Endothelial Keratoplasty in Eyes With Previous Trabeculectomy and Tube Shunt Procedures: Intraoperative and Early Postoperative Complications

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Purpose: To evaluate the intraoperative and early postoperative outcomes of Descemet stripping automated endothelial keratoplasty (DSAEK) in patients with previous glaucoma filtering surgeries.

Methods: A retrospective review of all DSAEK surgeries performed at one center comparing complications of DSAEK in eyes with previous glaucoma filtering procedures (study eyes) with a time-matched group of all other DSAEK cases (control eyes).

Results: There were 28 study eyes, 19 with previous trabeculectomies and 9 with previous glaucoma drainage devices (GDDs) and 431 control eyes. Study group intraoperative complications included 1 compromised bleb and 1 loss of donor tissue because of traumatic manipulation. One intraoperative complication, a perforation of the donor tissue, occurred in the control group. Venting stab incisions were used more often in study eyes (n = 5; 18%) than in control eyes (n = 12; 4.4%) (P = 0.002). GDD tubes were trimmed in 2 eyes (22%). No intraoperative manipulations were used to occlude the glaucoma filters or tubes. Postoperative complications in the study group included 1 dislocation (3.6%) and 1 decentered graft (3.6%) and 1 eye with loss of pressure control (3.6%), whereas in the control group, there were 10 dislocations (2.3%) and 1 decentered graft (0.2%) (P = 0.267 for dislocations and P = 0.118 for decentered grafts). One episode of pupillary block (0.2%) occurred in the control group, and none occurred in the study group. No primary graft failures occurred in either group.

Conclusions: DSAEK surgeries in eyes with previous glaucoma filtering procedures were performed without primary graft failure and with reasonably low dislocation (3.6%) and graft decentration (3.6%) rates. Although the intraoperative complication rate for the study group (7.1%) was higher than the rate for the control group (0.23%), excellent early postoperative outcomes can be achieved when DSAEK is performed in eyes with previous trabeculectomies and GDDs.

Key Words: endothelial keratoplasty, EK, Descemet stripping automated endothelial keratoplasty, DSAEK, Descemet stripping endothelial keratoplasty, DSEK, corneal transplants, glaucoma, complications of EK

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Endothelial keratoplasty (EK) involves the replacement of diseased recipient endothelium with healthy donor endothelium.[1–4] First introduced in the United States as deep lamellar endothelial keratoplasty by Terry et al[5] in March of 2000, this procedure rapidly developed from the earlier described techniques of posterior lamellar keratoplasty[2,6] and deep lamellar endothelial keratoplasty[7–14] to Descemet stripping endothelial keratoplasty[15–20] and to the most commonly used technique, Descemet stripping automated endothelial keratoplasty (DSAEK).[21] DSAEK uses the microkeratome to prepare the donor tissue and is either cut intraoperatively by the surgeon or "precut" by the eye bank. Currently, DSAEK is the standard of care for the treatment of pure endothelial failure.[19,21–27]

A great deal has been written describing quality of best spectacle–corrected visual acuity achieved early in the postoperative period resulting from this essentially refractive neutral procedure.[17,19,22,28,29] Additional benefits of DSAEK include no full-thickness corneal incisions resulting in increased wound stability and no corneal sutures theoretically decreasing the rate of postoperative infections and graft rejection episodes.[30]

Much has also been written regarding the new challenges facing EK surgeons with the unique complications arising in the form of graft dislocations ranging from as low as 1.5%[23] to as high as 82%[31] and pupillary block resulting from air or other gases left in the eye.[17,24] Additionally, primary graft failure, a rarity in penetrating keratoplasty (PK) has become

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much more common in EK ranging in studies from a rate of zero percent[23] to as high as 45%.[18–21,31] We have previously reported[23] minimal dislocations and zero primary graft failures and pupillary block episodes using our standard DSAEK technique. Many other DSAEK surgeons, using a variety of surgical techniques have also been able to decrease their complication rates with increasing experience.[17,18]

Multiple previous studies have addressed the difficulties of performing PK in eyes with previous trabeculectomies (trabs) and glaucoma drainage devices (GDD),[32–36] but there has only been 1 case report published that has specifically described DSAEK surgery success in 2 eyes with GDD.[37] We performed a retrospective review of our DSAEK series to identify all eyes undergoing DSAEK surgery in the presence of previous trabs and GDDs. We reviewed this group of patients to determine rates of intraoperative and early postoperative complications, and we compare the complication rate of this unique group of complex DSAEK cases with a time-matched group of DSAEK cases without prior glaucoma surgery.

METHODS

We performed a retrospective review of the data, which were gathered prospectively in our ongoing DSAEK clinical study. All eyes with previous glaucoma surgeries including those with trabs and those with GDDs were identified and designated as the "study group" for this analysis. Patient records were reviewed to identify intraoperative complications including damage or loss occurring at any time during surgery, leading to the inability to position the donor tissue on the posterior stoma of the recipient eye. The surgical notes were also evaluated for any significant intraocular trauma occurring during surgery, for example, iris tears or intraocular lens (IOL) dislocation. Records were also reviewed for notes of damage occurring to tubes or trab blebs. Additional surgical maneuvers used at the time of the procedure were also recorded. Postoperative complications such as graft dislocation or decentration, primary graft failure, and pupillary block glaucoma were recorded. This study group was then compared with a time-matched group of all other DSAEK surgeries performed at our center during the same period. These eyes without prior glaucoma surgery were designated as our "control group" for this analysis. Additionally, pre- and postoperative intraocular pressure (IOP) measurements and the number of pre- and postoperative glaucoma medicines used within both groups were noted.

Surgical Procedure

The majority of DSAEK cases (278) were performed by one surgeon [M.A.T.; 256 control and 22 study eyes (16 trabs and 6 GDD)], with the remaining 181 cases performed by novice EK surgeons [K.H., E.S.C., P.M.P., and N.S.; 175 control and 6 study eyes (3 trabs and 3 GDD)] at our institution. All surgeons used the exact same DSAEK surgical technique, described in detail elsewhere.[23]

A video of our technique using surgeon-prepared tissue was presented at the American Academy of Ophthalmology annual meeting in 2006 and can be found on the American Academy of Ophthalmology Web site (aao.scientificposters.com/vodAbstract.cfm?21, accessed October 4, 2007). A video of our DSAEK technique using "precut" donor tissue is shown in the journal Ophthalmology online video section (available at http:/aaojournal.org). These videos showing our DSAEK technique are also available on our research Web site of dlek-dsek.com.

Our technique involves the creation of a 5-mm tunneled scleral incision. The recipient is stripped of the diseased Descemet and endothelium, and the peripheral recipient stromal bed is subsequently scraped with a "Terry Scraper" (Bausch & Lomb Surgical, St. Louis, MO). The donor tissue is cut with punch trephine and is folded to create a 60/40 "taco" configuration for insertion with "Charlie" insertion forceps (Bausch & Lomb Surgical). The tissue is unfolded slowly and spontaneously, by deepening the chamber with balanced salt solution followed by the insertion of an air bubble to complete the unfolding. The anterior chamber is completely filled with air and surface sweeping is performed to remove interface fluid. If, either before insertion of the graft or after air is instilled into the eye, it is felt that sufficient back pressure from a complete anterior chamber air fill cannot be achieved, surface corneal "venting" stab incisions to remove fluid are placed. Routine corneal "venting" incisions are not used, however. A residual air bubble with a diameter of 9.0 mm or less is left to support the tissue with supine positioning for 1 hour. Care is taken to ensure that the residual air bubble left at the end of the surgery is freely mobile and not attached to the pupillary margin to avoid postoperative pupillary block.

Statistical Analysis

Data were analyzed using SPSS 12.0. All results were analyzed using χ^2 analysis. Significance was held at $P = 0.05$.

RESULTS

Patients

The study group was composed of 28 eyes of 26 patients with glaucoma and previous filtering surgery [trabs (n = 19) or GDD (n = 9)] that underwent DSAEK at our center between January 2005 and May 2008. The control group consisted of 431 eyes of 325 patients without a previous glaucoma filtering procedure that underwent DSAEK during the same period. Although the cause of endothelial failure in the study group and the control group were similar (Fuchs dystrophy, surgical induced edema, failed graft, and other), the ratios were not (Table 1). Specifically, there was a significantly higher proportion of patients in the study group with surgically induced

TABLE 1. Preoperative Cause of Endothelial Failure Leading to DSAEK

	Fuchs Dystrophy	Surgical Induced	Failed Graft	Other
Study, n (%)	6 (21)	17 (61)	4 (14)	1 (4)
Trab, n (%)	5 (26)	12 (63)	1 (5)	1 (5)
GDD, n (%)	1 (11)	5 (56)	3 (33)	0
Control	342 (79)	62 (14)	13 (3)	13 (3)
P	<0.001	<0.001	0.002	0.870

endothelial failure (61%) than in the control group (14%) ($P < 0.001$) and fewer eyes with Fuchs dystrophy in the study group (21%) compared with the control group (79%) ($P < 0.001$). There were also a higher percentage of eyes with previous failed grafts in the study group (14%) than in the control group (3%) ($P = 0.002$) (Table 1).

Two DSAEK surgeries were performed in a GDD study eye after the first graft developed late endothelial failure between the 6-month and 1-year follow-ups. An additional patient in the study group had DSAEK surgery performed in both eyes, both of which had previous trabs.

Intraoperative Procedures

Venting stab incisions to aid in removal of interface fluid were placed more often in the study group eyes than in the control group eyes. Stab incisions were placed in 5 study eyes (18%), whereas they were only placed in 12 control eyes (4.4%) ($P = 0.002$). Stab incisions were placed in the trab group in 3 of 19 eyes (16%) and in the GDD group in 2 of 9 eyes (22%). These rates of stab incision placement were also significant between each subset and the control (trab vs control $P = 0.021$ and GDD vs control $P = 0.03$); however, the difference between the trab group and the GDD group was not statistically significant ($P = 0.678$).

The additional surgical maneuver of trimming the GDD tube was performed in 2 eyes (22%); however, no attempt was made to occlude the glaucoma filter in any of the study eyes during the DSAEK surgery.

Concurrent intraocular procedures at the time of DSAEK surgery included phacoemulsification with IOL placement (triple procedure), IOL exchange, sutured IOL, vitrectomy, iridoplasty, and synechiolysis (Table 2). There was a higher rate of DSAEK triple procedures performed in the control group ($P < 0.001$). When excluding the triple procedure, the difference in the rate of the other concurrent intraocular procedures between the groups was not statistically significant ($P = 0.106$).

Intraoperative Complications

In the study group, there were 2 intraoperative complications (7%) as compared with 1 intraoperative complication in the control group (0.25%). This was statistically significant ($P < 0.001$). One complication in the study group occurred in the form of a ruptured bleb in an eye with a previous trab. This rupture of the bleb occurred during the routine digital massage compression used after the administration of the retrobulbar block anesthesia injection. The other complication in the study group occurred in an eye with a GDD. In this eye, excessive manipulation of the graft occurred with upside-down unfolding of the graft because of a large blood clot on the surface of the iris, which appeared after donor tissue insertion. Because the patient had a blind fellow eye and the upside-down position trauma to the graft was recognized, it was elected to immediately substitute a graft from a readily available donor at the time of the primary surgery. Therefore, intraoperatively, the graft was replaced with a new donor lenticule. The large iris-surface blood clot was first carefully removed before insertion of the second graft and the case proceeded without difficulty.

The majority of donor tissue used in this study was precut (82% and 68% for study and control group respectively $P = 0.126$); however, in the control group, a complication occurred before the use of precut tissue. During preparation of the donor, the microkeratome cut perforated the tissue through the endothelium. A backup tissue was cut successfully, and the procedure continued without further complications.

TABLE 2. Concurrant Intraocular Procedures Performed During DSAEK

	Control, n (%)	Study, n (%)	Trab	GDD
Triple procedure	228 (53)	1 (3.6)	1	0
IOL exchange	11 (2.5)	2 (7)	1	1
Sutured IOL	5 (1.2)	1 (3.6)	1	0
Anterior vitrectomy	14 (3.2)	2 (7)	1	1
Iridoplasty	1 (0.23)	2 (7)	1	1
Synechialysis	1 (0.23)	0	0	0
All concurrent procedures	260 (60)	8 (29)	5	3
Concurrent procedures excluding triple procedures	32 (7.4)	7 (25)	4	3

All concurrent procedures: control versus study $P < 0.001$.
Concurrent procedures excluding triple procedures: control versus study $P = 0.106$.

Postoperative Complications

The occurrence of postoperative graft dislocation between the study and the control groups was not statistically significant with 1 dislocation in the study group (3.5%) and 10 dislocations in the control group (2.3%) ($P = 0.267$). There was 1 decentered graft (3.5%) in the study group and 1 in the control group ($P = 0.118$). These cases have been described previously.[23] The decentration in the study group occurred in the eye with a trab in which the bleb leak occurred intraoperatively. There were no cases of pupillary block glaucoma in the study group and 1 case (0.2%) in the control group. No other early postoperative complications occurred.

Within the 1-month postoperative period, 3 eyes (10.7%) of the study group and 26 eyes (8.2%) of the control group with available data (n = 314) required the addition of glaucoma medications for pressure control ($P = 0.719$). There were 4 eyes (14.3%) of the study group and 51 eyes (17%) of the control group with available data (n = 299) that required additional pressure lowering drops by the 1-month follow-up ($P = 1.00$). One of the eyes that required additional glaucoma medications in the study group also required a repeated trab within the 1-month follow-up. This elevated IOP was noted at the 1-week follow-up visit. Although there was no obvious structural abnormality present in the anterior segment, the bleb was felt to no longer be functioning. After the repeated glaucoma surgery, the pressure was controlled at 5–7 mm Hg without medications (Table 3).

DISCUSSION

EK has gained widespread use in the treatment of endothelial dysfunction. While gaining popularity, this exciting technique can be applied to ever more complicated

cases. However, there is very little data published on the intraoperative and early postoperative complications of EK in complex cases such as those with filtering tubes and blebs in place before the DSAEK intervention.[37] In this report, we have reviewed the complications in our series of eyes with prior glaucoma surgery and compared these complex DSAEK cases to a time-matched control group of eyes without this specific comorbidity, which received the same DSAEK surgical procedure.

Intraoperative Procedures

The basic steps of the procedure, described in our prior publication,[23] were performed in an identical fashion by all surgeons at our center. We have described the use of venting stab incisions to release interface fluid as part of our technique when we feel that interface fluid cannot be removed in our usual fashion of sweeping the corneal surface with compression. We believe that removal of interface fluid is critical for good adherence of the donor tissue; however, this step of venting stab incisions is rarely performed in our standard DSAEK technique for cases with no alteration of the normal anterior chamber anatomy. Our experience shows that removal of this interface fluid is readily achieved when sweeping is performed in the presence of reasonable back pressure (approximately 55–65 mm Hg) from an anterior chamber air bubble. This sweeping maneuver may be less effective, however, and potentially deleterious when a firm air fill of the anterior chamber cannot be achieved, such as in cases with a fragile filtering bleb. In such instances, the addition of stab incisions is then employed for interface fluid removal. Although stab incisions are occasionally useful, we do not have a strictly defined protocol for employing them. The use of such incisions was therefore left to the discretion of the individual surgeon.

In all instances, when venting of stab incisions were used, they were performed in addition to our usual sweeping

TABLE 3. Pre- and Postoperative Individual Patient Data

Patient Number	Glaucoma Surgery	Concurrent Procedures	Intraoperative Complications	Stab Incisions	Dislocation	Preoperative IOP	Postoperative IOP (1 mo)	No. Preoperative Glaucoma Medicines	No. Postoperative Glaucoma Medicines (1 mo)	Additional Glaucoma Surgery Required (1 mo)
1	Trab	Iridoplasty	No	No	No	16	9	1	1	No
2	Trab	None	No	No	No	16	18	1	1	No
3	Trab	None	No	No	No	12	15	1	0	No
4	Trab	None	No	No	No	10	21	0	2	No
5	GDD	IOL exchange	No	No	No	18	17	0	0	No
6	Trab	None	No	Yes	No	17	15	5§	5§	No
7	Trab	None	No	Yes	No	20	19	2	2	No
8	Trab	Sutured IOL	No	No	No	10	10	0	0	No
9	Trab	None	No	No	No	16	13	0	0	No
10	Trab	None	No	Yes	No	10	6	0	0	No
11	Trab	None	No	No	No	13	13	1	1	No
12	Trab	Vitrectomy	No	No	No	14	8	1	0	No
13	Trab	None	No	No	No	12	18	3	3	No
14	GDD	Vitrectomy	No	No	No	17	10	0	0	No
15	GDD	None	No	No	No	13	13	3	3	No
16	Trab	None	No	Yes	No	12	11	0	0	No
17	Trab	IOL exchange	No	Yes	No	7	6	0	0	No
18	GDD	None	No	No	No	13	14	0	0	No
19	Trab	None	Yes*	No	Yes	6	20	0	2	No
20	GDD	None	Yes†	Yes	No	17	17	1	1	No
21	Trab	None	No	Yes	No	12	15	0	0	No
22	Trab	None	No	No	No	22	44	3	5§	Yes‡
23	Trab	None	No	No	No	18	12	3	3	No
24	GDD	None	No	No	No	23	22	3§	1	No
25	GDD	None	No	No	No	18	10	1§	0	No
26	GDD	Iridoplasty	No	Yes	No	15	11	0	0	No
27	GDD	None	No	No	No	22	15	3	3	No
28	Trab	Phaco	No	No	No	14	14	0	0	No

Postoperative time gate is 1 month after transplant.
*Intraoperative bleb leak.
†Second graft used intraoperatively because of upside-down graft trauma.
‡Trab—postoperative IOP: 5–7 mm Hg off of glaucoma medicines.
§One of glaucoma medications was oral acetazolamide.

maneuver. Of note, after surface sweeping in these cases, significant fluid was rarely discovered when the venting stab incisions were opened. This lead us to the conclusion that our surface compression sweeping had completely removed the interface fluid, and the venting incisions may not have been necessary after all. Although stab incisions were used more frequently in the study group than in the control group, even in the study group, incisions were not used in the majority (82%) of cases and a complete and firm anterior chamber air fill was obtained without difficulty despite the filtering tubes and blebs.

In the GDD group, 2 tubes were trimmed at the time of DSAEK. Both tubes were felt to extend further centrally than necessary. These tubes were trimmed before insertion of the donor graft because it was felt that they might interfere with the opening and position of the graft. In addition, tube trimming was performed to prevent tube contact with the graft once final positioning was achieved. They were trimmed back conservatively, so as to be peripheral to approximately the central 8-mm zone but still present well within the confines of the anterior chamber. No difficulties were encountered as a result of this maneuver in either case, and the grafts were then inserted and opened in position without difficulty.

There was a higher rate of DSAEK triple procedures performed in the control group compared with the study group ($P < 0.001$), and this could theoretically have had an influence on the results; however, previous studies have demonstrated that there is no increase in complications when DSAEK is performed with concurrent cataract surgery.[38,39] In addition, when looking at other concurrent procedures at the time of DSAEK including IOL exchanges, sutured IOLs, vitrectomies, iridoplasties, and vitrectomies, there was no significant difference ($P = 0.106$) between the 2 groups. It is unlikely, therefore, that these other concurrent procedures, which are often thought to increase the complexity of a surgery, significantly influenced the outcomes between the 2 groups.

Intraoperative Complications

There was no significant difference in the postoperative complication rate between the study and control groups. Looking at the few intraoperative complications more closely, it is important to note that the complication involving the ruptured bleb in a trab eye was likely responsible for postoperative hypotony in this eye. This hypotony may have led secondarily to postoperative decentration of the graft. The bleb in this eye was small and cystic, likely predisposing it to this complication. The leak was noted soon after the eyelid speculum was placed. We believe it occurred after pressure was applied to the eye after placement of the retrobulbar block. A decision was made not to try to close the fragile cystic bleb at the completion of the case in the hopes that the leak would seal without intervention. Unfortunately, on the first postoperative day, the bleb was still leaking aqueous, the eye was soft, and the graft was decentered superonasally. We believe that postoperative hypotony can lead to distortion of the cornea and decentration of a graft as it may have done in this case.

In contrast to the above complication, the intraoperative complication that required tissue replacement intraoperatively occurring in the GDD eye was not believed to be related to the presence of the previous glaucoma surgery. Instead, this complication was caused by a blood clot formation in the anterior chamber that developed after an iris vessel bled from iris contact with the I/A tip during suction and Healon removal. Intraoperatively, the surgeon was concerned that the endothelium of the donor graft had been significantly traumatized while attempts were made to unfold it. The DSAEK was being performed in the only seeing eye in this monocular patient. Given the presence of readily available corneal tissue for subsequent cases that day, the surgeon decided to discard the initial graft and replace it, rather than to continue the surgery with the original donor tissue. It is possible that the traumatized tissue would have succeeded in clearing the recipient cornea; however, it is also possible that the tissue would have failed early, thus requiring a second operation in the already diseased only eye in this patient. The replacement graft did well, without any problems postoperatively.

The intraoperative complication in the control group was related to tissue cutting rather than the surgery itself. This occurred when a donor tissue with previous laser in situ keratomileusis surgery was perforated with the microkeratome. At the time of this perforation, the surgeon was not checking corneal thickness before the cap resection and was using a 300-μm head for all donor cutting. With the knowledge that the donor tissue could potentially perforate, an additional donor tissue was made available for this surgery. After perforation of the initial donor tissue occurred, this additional normal thickness second tissue was then cut without complication and was successfully used in this surgery.

As a result of this experience, we now feel that corneal thickness measurements should be taken before resection of donor tissue to aid in the appropriate selection of a 250-, 300-, or 350-μm head. At our center, we have now transitioned to using only precut donor tissue, cut in advance by the Lions Eye Bank of Oregon. This has made the risk of perforating tissue intraoperatively a moot point.

Postoperative Complications

There was no significant difference in postoperative complications between the groups. The 1 decentered graft and all dislocated grafts in both groups were repositioned and reattached without difficulty in the operating room under topical anesthesia. All repositioned grafts remained attached postoperatively and all corneas cleared in the early postoperative period.

The patient with the pupillary block presented at the first postoperative visit with an elevated IOP (>50 mm Hg) with a narrowed angle. The patient was taken to the operating room that day, and the bubble was removed. The pressure returned to normal and the graft remained attached and clear. Uncorrected vision at 1 month was 20/25.

No primary graft failures occurred in either group. All grafts cleared the recipient corneas of edema in the early postoperative period. We therefore feel that, using our specific DSAEK technique, complex cases do not significantly increase the risk of graft failure.

This study was aimed at evaluating the early postoperative results of DSAEK surgery in eyes with previous

trabs and GDDs. Because we were evaluating postoperative results at only 1 month, no attempt was made to determine longer term outcomes such as vision, astigmatism, rejection episodes, endothelial cell densities, or rates of late endothelial failure in these patients. Long-term outcomes such as rejection and late endothelial failure will be more clearly determined only after these eyes have reached follow-up of at least 2–3 years. Nonetheless, we have already experienced that 1 eye in the study group required a repeat DSAEK surgery after the first graft suffered late endothelial failure. This may be an indication that DSAEK surgery may have similar decreased rates of graft survival as found when PK is performed in the presence of previous glaucoma surgery.[32–36] A true comparison of graft survival and glaucoma control between DSAEK and PK in eyes with previous glaucoma surgery can only be made after this series of DSAEK eyes reaches much longer follow-up.

This study was not designed to assess glaucoma control after the DSAEK procedure. A true evaluation of glaucoma "control" versus "progression" would require the prospective quantifiable assessment of optic nerve function, including optic nerve analysis and/or automated visual field testing for each patient. This systematic testing for glaucoma would require a prospective study design, which outlines those specific outcome measurements in advance and therefore was not analyzed as part of this retrospective study of our DSAEK subgroup. We were, however, able to assess the impact on the measured IOP by DSAEK surgery in both groups. When looking at the preoperative and 1-month postoperative IOPs and the preoperative and postoperative glaucoma medications, it seems that a certain percentage of patients in both study and control groups had pressure control issues within the first postoperative month, but the difference between the groups was not statistically significant. Additionally, 1 patient in the study group lost pressure control early after the DSAEK surgery. This loss of pressure control was, therefore, most likely directly related to the procedure; however, steroid response glaucoma could not be ruled out. This patient required additional glaucoma surgery in the form of a trab to regain pressure control and now is medication free with low IOPs.

These results may give some idea of the acute impact that DSAEK surgery has on the function of a trab or filtering blebs. No comment can be made at this time, however, regarding the effect of DSAEK surgery on the long-term function of the filters in these eyes.

SUMMARY

This study demonstrates that successful early outcomes can be achieved in this subset of patients with low dislocation and decentration rates, no pupillary block glaucoma, and no primary graft failures. Therefore, these patients with previous glaucoma surgery and endothelial failure may also benefit significantly from DSAEK. Certainly, although the acute complications from DSAEK in complex eyes can be quite low, long-term follow-up will be needed to determine if other objective results are as favorably delivered.

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