

Comparison of long-term outcomes of trabeculectomy and risk factors for failure in eyes post penetrating keratoplasty or Descemet's stripping endothelial keratoplasty

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Purpose: To evaluate the outcomes of trabeculectomy, graft survival, and risk factors for failure in post penetrating keratoplasty (PK) and Descemet's stripping endothelial keratoplasty (DSEK) eyes. **Methods:** We reviewed charts of eyes that underwent trabeculectomy for post keratoplasty glaucoma PK [25 eyes] and DSEK [14 eyes] between 1993 and 2019. The demographics, clinical features, and surgical outcomes were evaluated. Success of trabeculectomy was defined as complete when the intraocular pressure (IOP) was >5 and ≤ 21 mmHg without antiglaucoma medications (AGM) and qualified with AGM. Clear and compact graft was considered for graft success. **Results:** Median (interquartile range [IQR] preoperative IOP in post-PK eyes and post-DSEK eyes was comparable, 32 (28–38) vs. 31.5 (25–36) mmHg, $P = 0.38$). Median number of preoperative AGMs was comparable ($P = 0.78$). Median postoperative follow-up was longer in post-PK, compared with post-DSEK, 2.5 (1.3–3.3) vs. 1 (0.3–2.9) years ($P = 0.05$). Kaplan–Meier survival estimates for complete and qualified success of trabeculectomy at 3 years were 23.7% and 73.3%, respectively, for PK and 45.8% and 71.6%, respectively, for DSEK. Kaplan–Meier survival estimates for graft survival were 91.8% up to 3 years for PK and 100% until 2 years and 77.8% at 3 years for DSEK. Higher IOP prior to trabeculectomy was a risk factor for failure of trabeculectomy ($P = 0.03$) and older age was a risk factor for graft failure ($P = 0.05$) in PK eyes. Number of prior corneal surgeries ($P = 0.05$) was associated with failure of trabeculectomy and graft failure in post-DSEK eyes. **Conclusion:** Trabeculectomy had moderate qualified success in post-PK and DSEK eyes at 3 years. Higher pretrabeculectomy IOP and higher number of prior corneal surgeries were significantly associated with failure of trabeculectomy in PK and DSEK eyes, respectively.

Key words: Descemet's stripping endothelial keratoplasty, glaucoma, graft survival, penetrating keratoplasty, trabeculectomy success

Glaucoma post keratoplasty is multifactorial. The proposed mechanisms are the distortion of angle structures with the collapse of trabecular meshwork beams, prolonged inflammation, tightness of sutures, use of steroids, distorted anterior segment with synechial angle closure, and preexisting glaucoma.^[1–3] Since its first report by Irvine^[4] in 1969, several studies have reported incidence of the elevated intraocular pressure (IOP) in post penetrating keratoplasty (PK) eyes to range between 9% and 13% in the early postop period and 18% and 35% in the late postop period. Similarly, a rise in IOP is seen in post-Descemet's stripping endothelial keratoplasty (DSEK) eyes,^[5] with incidence ranging from 15% to 35%.^[6,7]

Trabeculectomy is needed for IOP control in eyes refractory to medical management. Trabeculectomy with or without mitomycin C (MMC) in these eyes has a high failure rate (49.15%) due to associated comorbidities such as perilimbal scarring and fibrosis, presence of peripheral anterior synechiae (PAS), and aphakic status.^[8,9] The only report comparing the outcomes of trabeculectomy with MMC

in post-DSEK and post-PK eyes at 12 months showed 70.1% mean IOP reduction post-DSEK compared with 55.6% in post penetrating keratoplasty eyes.^[10] So far in the literature, there are no reports on long-term outcomes of trabeculectomy in post-PK and post-DSEK eyes.

The primary objective of our study was to evaluate the long-term outcomes of trabeculectomy following penetrating and endothelial keratoplasty and the secondary objective was to evaluate the graft clarity and survival.

Methods

This was a retrospective study of patients with post-PK and post-DSEK glaucoma that underwent either trabeculectomy or trabeculectomy with MMC by a single surgeon at a tertiary eye care center in south India. This study was approved by the Institutional Review Board and followed the tenets of the

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Declaration of Helsinki. An increase in IOP >21 mmHg with or without disc changes in more than three visits and those eyes with IOP <21 mmHg but on AGMs or underwent prior trabeculectomy was considered as post-PK/post-DSEK glaucoma.

A chart review of those patients who underwent trabeculectomy (PK = 6 and DSEK = 2) or trabeculectomy with MMC (PK = 19, DSEK = 12) between 1993 and 2019 was performed. Baseline demographic details including age, gender, study eye (right or left eye), corneal pathology diagnosis, prior corneal surgeries, any intraocular surgery with or without concurrent surgical interventions, prior glaucoma diagnosis, prekeratoplasty IOP, pretrabeculectomy IOP, type of glaucoma filtering surgery, disc findings, and antiglaucoma medications (AGM) before and after surgery, IOP on postoperative period *day 1, month 1, month 3, month 6, year 1*, and till the last follow-up were noted. Details about corneal graft clarity and compactness, best-corrected visual acuity (BCVA) before and after corneal and glaucoma surgeries were considered. BCVA was converted to logarithm of the minimum angle of resolution (LogMAR) unit for analysis purposes. Patients with a minimum of 1-year follow-up were included. Good corneal clarity and compactness of graft were considered graft success. Loss of corneal clarity and the need for repeat surgery were considered graft failures. Complete success was defined as IOP >5 and ≤21 mmHg and qualified success as IOP >5 and ≤21 mmHg with AGMs. IOP <5 and >21 mmHg with AGM were considered trabeculectomy failure.

Surgical technique

All the surgeries were performed under peribulbar anesthesia under aseptic precautions after obtaining consent for the same. A fornix-based or limbal-based conjunctival flap was made as per the surgeons' discretion. Adequate cautery was applied. Antifibrotic MMC was used based on the health and thickness of the conjunctiva and sclera. Three week-cel pledgets soaked in MMC (0.04%) were placed in subconjunctival space and a broad area of application from 10 to 2 'O clock while avoiding the conjunctival edge away from the pledgets. MMC was washed with copious saline in cases where trabeculectomy with MMC was planned. A triangular partial thickness scleral flap was made approximately 4 × 4 mm size dissected anteriorly till clear cornea. A 2 × 2 mm corneoscleral block was excised to make the ostium and a 1 × 1 mm peripheral iridectomy was performed through the ostium. A paracentesis was made even before the deep block excision, and the AC was reformed using an air bubble or saline. Scleral flap was closed with 1 or 2 10-0 nylon sutures by titrating the flow. Additional releasable sutures were applied when needed. Conjunctiva was closed with two to three wing sutures in fornix-based and one continuous suture in limbal-based trabeculectomies. Subconjunctival dexamethasone 0.5 mL was given at the end of surgery.

All patients were started on prednisolone acetate 1% eye drops 8–10 times a day and tapered as needed and maintained at 3–4 times a day based on the graft clarity and intraocular inflammation. Topical moxifloxacin 1% eye drops for 1 week and homatropine 2% eye drops were used for 2–4 weeks based on the requirement.

Statistical analysis

The statistical analysis was performed using STATA v14 (Stata Corp, College Station, TX, USA). The continuous data were

checked for the normality of distribution by the Shapiro–Wilk test. Descriptive statistics were represented as median with interquartile range (nonparametric data) or means ± standard deviation (parametric data). Continuous data between PK and DSEK groups were compared by Mann–Whitney test (nonparametric data or parametric data with unequal variance) and Student's *t*-test (parametric data). Categorical data were described in proportions and compared using *t*-test/Fischer's exact test. The outcome measures were compared in both groups at the final follow-up visit. Kaplan–Meier analysis was generated to show the cumulative survival of graft and trabeculectomy for the study duration. For all analyses *P* value of ≤0.05 was considered statistically significant.

Results

In our study, data of 25 eyes of 24 subjects with post-PK glaucoma and 14 eyes of 14 patients with post-DSEK glaucoma that underwent trabeculectomy were analyzed. The demographics and presenting features are summarized in Table 1.

Systemic associations (either diabetes mellitus alone or with hypertension) were also higher in post-DSEK (21.4%). A comparable number of previous trabeculectomy with MMC was performed in post-PK (3 out of 25 eyes) compared with post-DSEK (1 out of 14 eyes), *P* = 1.00. Seven eyes in post-PK (4 eyes with PK, 1 eye with DSEK, 2 eyes with PK followed by cataract surgery) and one eye (DSEK) in post-DSEK group had previous corneal surgery. Six of the 25 eyes had previous glaucoma surgery (3 trabeculectomy with MMC, 2 trabeculectomy with trabeculectomy) in post-PK group, whereas three out of 14 eyes had prior glaucoma surgery (1 each of trabeculectomy, trabeculectomy with MMC, trabeculectomy, and trabeculectomy) in post-DSEK group.

Median preoperative IOP was comparable in both groups (*P* = 0.38) in PK (32 mmHg) and DSEK (31.5 mmHg). The median number of preoperative AGM was comparable in both groups (3, *P* = 0.78). The preoperative endothelial count was not significant statistically between groups (*P* = 0.81) as shown in Table 2.

Following trabeculectomy, 7/25 (28%) eyes in post-PK and 8/14 (57.14%) eyes in post-DSEK had complete success, 18/25 (72%) eyes in post-PK and 11/14 (78.5%) eyes in post-DSEK had qualified success, and eight eyes in post-PK (33.3%) and three eyes (21.4%) in post-DSEK failed (IOP uncontrolled despite medications). The median time to failure of trabeculectomy in post-PK eyes was 1.75 years (IQR 0.6–2.95 years) and in post-DSEK was 0.75 years (IQR 0.2–2.3 years), *P* = 0.02. The median time to failure following trabeculectomy in PK grafts was 2.2 years (IQR 1.8–3.9) and in DSEK grafts was 2.9 years (IQR 1.2–3.9). Following trabeculectomy, 19/25 (76%) eyes in post-PK and 6/14 (42.8%) eyes in post-DSEK had IOP elevation in the postoperative period. The mean time of the rise in IOP in both groups was comparable at 4 months, *P* = 0.97. The median follow-up was longer (*P* = 0.05) in post-PK (2.5 years) than post-DSEK eyes (1 year). The median time interval between corneal surgery and trabeculectomy was 5.8 months in post-PK group versus 11.2 months in post-DSEK group as shown in Table 3.

Six patients in post-PK group needed surgical interventions for control of IOP (one eye underwent bleb needling followed by TSCPC, one eye underwent bleb resuturing, one eye

Table 1: Basic demographic characteristics and presenting features of the study subjects

Parameters	Post-PK	Post-DSEK	P
	25 eyes	14 eyes	
	24 patients	14 patients	
Age at presentation (years), median (interquartile range)	34.9 (19.1-47)	44.8 (15.6-60)	0.29
Male: Female	14:10	10:4	0.65
Systemic comorbidities			
DM	1 (4.2%)	2 (14.3%)	0.54
HTN	0 (0%)	1 (7.1%)	0.37
Both DM and HTN	0 (0%)	3 (21.4%)	0.04
Previous glaucoma surgeries			
Trabeculectomy	2 (8%)	2 (14.1%)	0.36
Trabeculectomy + MMC	3 (12%)	1 (7.1%)	1.00
Previous corneal surgeries			
PK	4 (16%)	0 (0%)	0.28
DSEK	1 (4%)	1 (7.1%)	1.00
PK followed by cataract surgery	2 (8%)	0 (0%)	0.53
Lens status			
Clear lens	2 (8%)	4 (28.6%)	0.16
Aphakia	4 (16%)	2 (14.3%)	1.00
Pseudophakia	9 (36%)	6 (42.9%)	0.92
Cataract	3 (12%)	2 (14.3%)	1.00
No view of lens status	7 (28%)	0 (0%)	0.04
Current glaucoma surgery			
Trabeculectomy: Trabeculectomy with MMC	6:19	2:12	0.69

DSEK, Descemet's stripping endothelial keratoplasty; DM, diabetes mellitus; HTN, hypertension; MMC, mitomycin-C; PK, penetrating keratoplasty. Highlighted in bold indicates statistically significant between both groups

Table 2: Preoperative characteristics of study subjects

Parameters	Post-PK	Post-DSEK	P
IOP prior to corneal surgery (mmHg), median (IQR)	17.5 (12-19)	15 (13-19)	0.56
BCVA prior to glaucoma surgery			
PL/PR	1 (4%)	0 (0%)	1.00
Rest in logMAR (median, IQR)	1.00 (0.60-2.78)	0.75 (0.60-1.20)	0.18
Pre-op AGM, median (IQR)	3 (2-4)	3 (2-4)	0.78
Pre-op IOP (mmHg), median (IQR)	32 (28-38)	31.5 (25-36)	0.38
Graft size (mm), median (IQR)	8 (7.75-8.50)	8 (7.75-8.00)	0.17
Preoperative endothelial cell count, means \pm SD	2848.4 \pm 395.5	2882.7 \pm 213	0.81
Preoperative disc, median (IQR)	0.70 (0.65-0.90)	0.78 (0.70-0.80)	0.86

AGM, antiglaucoma medication; BCVA, best-corrected visual acuity; DSEK, Descemet's stripping endothelial keratoplasty; FFL, fixing and following light; IOP, intraocular pressure; IQR, interquartile range; PK, penetrating keratoplasty; PL, perception of light; PR, projection of rays; SD, standard deviation

had repeat trabeculectomy, one eye had Ahmed glaucoma valve implantation, and one eye each had cyclocryotherapy and TSCPC; none in post-DSEK group needed additional intervention for IOP control.

Kaplan–Meier analysis was performed to assess the survival of trabeculectomy and grafts in both groups. The complete success of trabeculectomy was higher in post-DSEK compared with post-PK but was not statistically significant ($P=0.18$). The complete success of trabeculectomy at 1 year, 2 years, and 3 years was $37.9 \pm 10.3\%$, $31.6 \pm 10.4\%$, and $23.7 \pm 10.4\%$, respectively, in post-PK. The complete success of trabeculectomy in post-DSEK was $57.3 \pm 15.2\%$ at 1 year and $45.8 \pm 15.2\%$ at 2nd and 3rd year.

The qualified success of trabeculectomy was comparable in post-DSEK with the success of $71.6 \pm 14.4\%$ till 3 years while post-PK had a success of $79 \pm 8.4\%$ at 1 year and $73.3 \pm 9.5\%$ thereafter till 3 years ($P=0.81$), Fig. 1.

Descemet's stripping endothelial keratoplasty grafts survived better than PK grafts till 2 years after trabeculectomy. The success of graft survival in post-PK was $91.8 \pm 5.5\%$ till 3 years while it was 100% till 2 years and dropped to $77.8 \pm 13.9\%$ at the end of 3 years in post-DSEK. This difference was not statistically significant ($P=0.28$). The endothelial count's post PK/post-DSEK were comparable postoperatively, $P=0.50$ as shown in Table 3.

Table 3: Postoperative clinical parameters of the study subjects

Parameters	Post-PK (n=25)	Post-DSEK (n=14)	P
Post-op IOP day 1 (mmHg), median (IQR)	12.5 (9-18)	6 (5-13)	0.22
Post-op IOP month 3 (mmHg), median (IQR)	15 (12-22)	11 (8-21)	0.26
Post-op IOP month 6 (mmHg), median (IQR)	17.5 (14-25)	14 (7-20)	0.13
Post-op year 1 (mmHg), median (IQR)	18 (12-25)	19.5 (17-20)	0.97
IOP at last follow-up (mmHg), median (IQR)	17 (12-22)	12.5 (10-20)	0.08
AGM at last follow-up, median (IQR)	2 (1-3)	0.5 (0-2)	0.03
BCVA at last follow-up			
FFL/PL/PR	4 (16%)	0 (0%)	0.28
Rest in LogMAR (median, IQR)	0.90 (0.60-1.79)	0.90 (0.48-1.18)	0.61
Duration between corneal and glaucoma surgeries (months), median (IQR)	5.8 (2.5-10)	11.2 (3.5-19.2)	0.16
Postoperative endothelial count, means±SD	1413±638	1691±498	0.50*
Follow-up (years), median (IQR)	2.5 (1.3-3.3)	1 (0.3-2.9)	0.05
Graft failure n/N (%)	2/25 (8%)	3/14 (21.43%)	0.32#
Time to graft failure in years median (IQR)	2.2 (1.8-3.9)	2.9 (1.2-3.9)	0.26*
Complete success of trabeculectomy n/N (%)	7/25 (28%)	8/14 (57.14%)	0.09#
Qualified success of trabeculectomy n/N (%)	18/25 (72%)	11/14 (78.5)	0.72#
Complete failure of trabeculectomy n/N (%)	8/25 (33.3%)	3/14 (21.4%)	0.71#
Time to trabeculectomy failure in years median (IQR)	1.75 (0.62-2.95)	0.75 (0.26-2.3)	0.02*
Number of eyes with IOP elevation post trabeculectomy	19/25 (76%)	6/14 (42.8%)	0.07#
Mean time to rise in IOP post trabeculectomy in years (SD)	0.49 (0.69)	0.50 (0.49)	0.97*

DSEK, Descemet's stripping endothelial keratoplasty; FFL, fixing and following light; IOP, intraocular pressure; IQR, interquartile range; PK, penetrating keratoplasty; PL, perception of light; PR, projection of rays. *Comparison by t-test of unequal variance; #Comparison by Fischer's exact test; SD, standard deviation. Highlighted in bold indicates statistically significant between both groups

Multiple parameters were considered for the survival of trabeculectomy and graft. Univariate regression analysis was done to understand the risk factors for failure of trabeculectomy and graft in the study cohort. The number of prior corneal surgeries affected both trabeculectomy and graft survival in post-DSEK ($\beta = 0.84$, $P = 0.05$) but not in post-PK eyes ($\beta = 0.15$, $P = 0.2$). Pretrabeculectomy IOP was a risk factor for trabeculectomy failure with worsening of glaucoma in post-PK ($\beta = 0.02$, $P = 0.03$) but not in post-DSEK eyes ($\beta = -0.12$, $P = 0.43$). Older age was also risk factor in post-PK ($\beta = 0.002$, $P = 0.05$) eyes for graft failure but not in post-DSEK eyes ($\beta = -0.007$, $P = 0.07$) as shown in Table 4.

Discussion

Managing glaucoma in keratoplasty poses several challenges as there is distortion of anterior segment, which gets complicated with usage of steroids, limited options of medications, and their toxicity on ocular surface. Surgery may not be straightforward and anterior chamber architecture/organization needs a careful assessment prior to trabeculectomy. Risk of graft failure exists with any medical or surgical intervention after keratoplasty.^[11] Hence, the two important considerations are the effect of glaucoma on graft clarity and worsening of glaucoma causing irreversible vision loss by optic nerve damage.^[2] Hence, controlling the IOP in these eyes is critical for maintaining graft clarity and for preserving optic nerve function. Medically uncontrolled glaucoma needs surgery, trabeculectomy, and tube implants being the preferred procedures.^[12-15] Studies have shown that graft survival was less in eyes with trabeculectomy and greater with implant surgery.^[3,16] Although tube implants may have better success rates, higher graft failure in eyes with

implants would favor trabeculectomy.^[17] Akdemir *et al.*^[18] have noted that Ahmed glaucoma valve (AGV) had better IOP control in 64.2% versus 46% in trabeculectomy group but AGV had higher endothelial cell loss. The success rates of trabeculectomy are shown to vary in eyes with full-thickness penetrating keratoplasty and endothelial keratoplasties.^[2,19] In our study, we found that trabeculectomy success is comparable in post-PK (73.3%) and post-DSEK eyes (71.6%) at the end of 3 years. In our study, it was noted that trabeculectomy failed earlier in DSEK eyes, whereas graft failed earlier in PK eyes. The number of prior corneal procedures and pretrabeculectomy IOP were found to be associated with trabeculectomy and graft failure. Older age group was found to have higher risk of graft failure, especially in post-PK eyes.

In a report by Sharma *et al.*^[20] the postoperative IOP elevation was significantly higher in post-PK eyes compared with post-DSEK eyes and needed a higher number of AGMs at 6 months. The rate of IOP elevation in post-PK eyes (60%–68%) was higher compared with post-DSEK eyes (20%–23%) at 6 months. In our study, the post trabeculectomy elevation of IOP was higher in post-PK eyes (76%) when compared with post-DSEK eyes (42%), especially at 4-months postoperative period and not significant statistically between both groups. Reported success rates of trabeculectomy in these eyes with multiple interventions are poor when compared with eyes with uncomplicated primary glaucoma.^[21] Bleb failure as mentioned earlier can be attributable to perlimbal scarring, prolonged inflammation, prolonged antiglaucoma medication use, which compromise the conjunctival health leading to fibrosis. The use of antiglaucoma medications can also affect the outcome of trabeculectomy as it changes the internal milieu

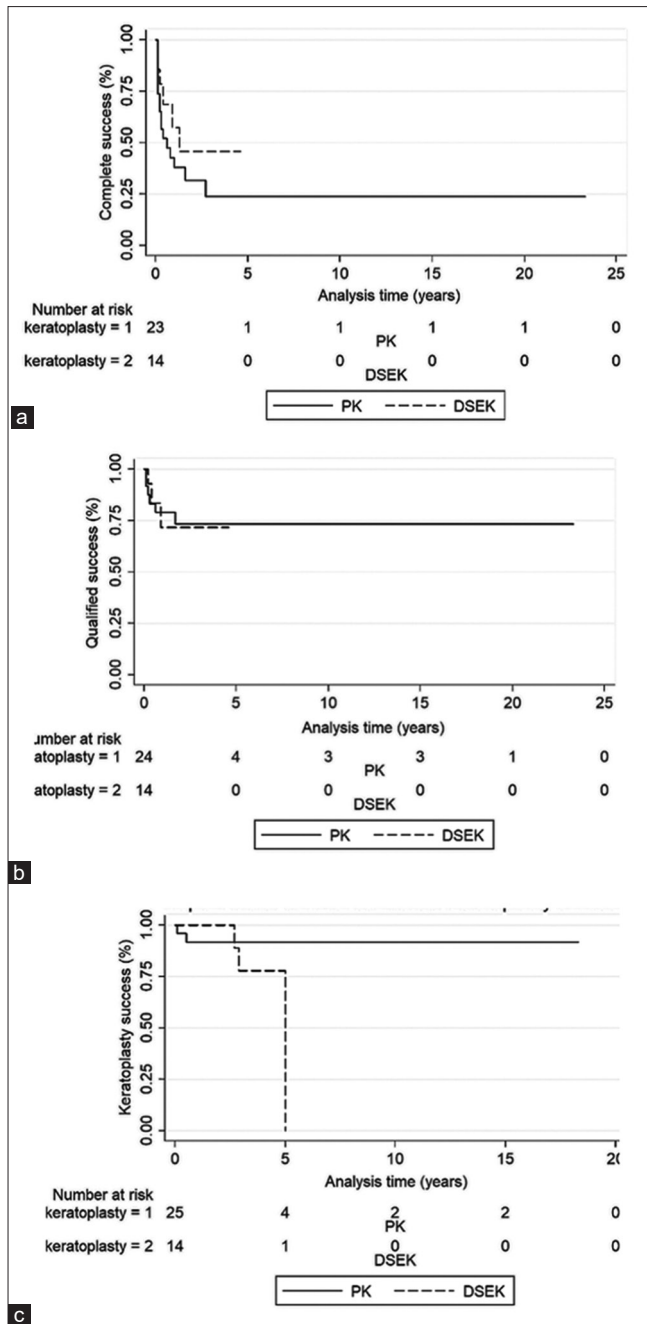


Figure 1: Kaplan–Meier survival graph showing complete success of trabeculectomy (a), Qualified success of trabeculectomy (b) and survival curve for keratoplasties (c). (a) 38% and 23% at 1 year and 3 years, respectively, in PK; 57% and 45% at 1 year and 3 years, respectively, in DSEK group. (b) 79% and 73% at 1 year and 3 years, respectively, in PK, which remained so till last follow-up and 71% from 1st year till 3 years in DSEK group. (c) overall graft survival was 91% in PK and 100% in DSEK till 2 years, it reduced to 77% at 3 years in DSEK group. DSEK, Descemet’s stripping endothelial keratoplasty; PK, penetrating keratoplasty

of the conjunctiva with upregulation of myofibroblasts in the conjunctival stroma.^[8,9]

Our study showed that complete success of trabeculectomy in post-DSEK eyes was comparable with post-PK eyes at the

end of 3 years (post-DSEK, 45.8%, post-PK, 23.7%, $P = 0.18$). The qualified success at the end of 3 years was also comparable in both groups (post-PK 73.3%, post-DSEK 71.6%, $P = 0.81$). Despite maximal treatment post trabeculectomy, 33.3% (8 of 25 post-PK eyes) and 21.4% (3 of 14 post-DSEK eyes) had failure, i.e., uncontrolled IOP. The failure could be attributed to the complexity of these cases at initial presentation like posttrauma, sclerocornea, and aphakia after complicated cataract surgery. Repeat intervention was needed in three of these eyes (one eye had cyclocryotherapy, one eye had repeat trabeculectomy, and one eye had TSCPC) for uncontrolled IOP. The median time to failure of trabeculectomy was earlier in post-DSEK eyes than post-PK eyes (0.75 years vs. 1.75 years, $P = 0.02$). We assume that poorer trabeculectomy survival in post-DSEK eyes could be due to severe preexisting corneal pathology, shallow anterior chamber, and longer duration of steroid use that could contribute to severe glaucoma.

Corneal grafts survival was comparable in post-PK and post-DSEK eyes at the end of 3 years (91.8% vs. 77.8%, $P = 0.28$). In our study, two out of 25 PK eyes (8%) and three of 14 DSEK eyes (21.4%) had failure. The median time to failure of graft post trabeculectomy was longer in DSEK eyes than in PK eyes (2.9 years vs. 2.2 years, $P = 0.18$). We presume that early failure of graft in PK eyes could be due to low endothelial counts along with complex cases with probably multiple sutures causing angle distortion, PAS.

There is limited literature evaluating outcomes of trabeculectomy in post-DSEK eyes, whereas there are several studies on trabeculectomy outcomes in post-PK eyes.^[10,12,22,23] Ishioka *et al.*^[22] have shown better outcomes of trabeculectomy with MMC in post-PK eyes (73% success) compared with trabeculectomy only (25% success), $P = 0.002$ at the end of 36 months. The success rate of trabeculectomy range from 67% to 77% at 1 year, which reduced to 50% at the end of 2 years.^[8,12,24] The qualified success of trabeculectomy in our series in post-PK eyes was 73.3% and post-DSEK was 71.6%, similar to reported literature. Boey *et al.*^[10] compared outcomes of trabeculectomy with MMC after DSEK versus PK. The DSEK group achieved a 70.1% mean IOP reduction compared with 55.6% in the penetrating keratoplasty group at 12 months.

In a study by Boey *et al.*^[10], the rate of graft failure after trabeculectomy with MMC was 10% at 12 months and was similar in post-PK and post-DSEK eyes. Figueiredo *et al.*^[24] reported 78% graft clarity in post-PK eyes 16 months following trabeculectomy with MMC. Graft survival in our series was 91.8% in post-PK and 77.8% in post-DSEK eyes, almost similar to that reported in other studies.

In a study by Vajaranant *et al.*^[5] evaluating glaucoma in post-DSEK eyes, in eyes without preexisting glaucoma, the incidence of IOP elevation was 35% and at the end of 12 months, 0.3% of eyes needed glaucoma surgery. However, they have not mentioned graft survival or the outcomes of trabeculectomy in their study.

Failure of trabeculectomy in these eyes leads to a further rise in IOP that decompensates the endothelium that causes secondary endothelial failure leading to graft failure/rejection. With challenges in the diagnosis and treatment, identification of risk factors is of paramount importance for prognostication. We have studied risk factors for trabeculectomy and graft survival.

Table 4: Univariate regression model showing the effect of risk factors for trabeculectomy and graft failure

Parameters	Coefficient for PK	P	Coefficient for DSEK	P
Risk factors for trabeculectomy failure				
Age	-0.001	0.85	-0.006	0.16
Previous glaucoma surgery	-0.20	0.37	0.15	0.60
Number of previous corneal surgeries	-0.16	0.4	0.84	0.05
IOP precorneal surgery	0.02	0.35	0.013	0.62
Pretrabeculectomy IOP	0.02	0.03	-0.009	0.44
Pretrabeculectomy number of AGM	-0.04	0.59	-0.13	0.43
Graft size	0.019	0.89	-0.30	0.08
Risk factors for graft failure				
Age	0.002	0.05	-0.007	0.07
Previous glaucoma surgery	0.114	0.4	0.15	0.6
Number of previous corneal surgeries	0.15	0.21	0.84	0.05
IOP precorneal surgery	-0.0006	0.95	0.00	0.97
Pretrabeculectomy IOP	-0.005	0.3	0.002	0.87
Pretrabeculectomy number of AGM	-0.06	0.14	-0.12	0.43
Graft size	-0.013	0.86	-0.30	0.08

AGM, antiglaucoma medication; DSEK, Descemet's stripping endothelial keratoplasty; IOP, intraocular pressure; PK, penetrating keratoplasty. Highlighted in bold indicates statistically significant

Previous corneal surgery is a risk factor for trabeculectomy and graft failure in post-DSEK eyes. Although our sample size and number of eyes with prior corneal surgery in our cohort is small, it appears to be a significant predictor of failure that needs to be studied in a large sample size. Ayyala has reported three times higher risk of graft rejection with every additional PK.^[12]

Higher IOP before glaucoma surgery is a risk factor for trabeculectomy failure in post-PK eyes. Increasing age is also a risk factor for graft failure in post-PK eyes. We have not noticed graft size as a risk factor for failure ($\beta = -0.013$, $P = 0.86$ for PK, $\beta = -0.30$, $P = 0.08$ for DSEK) in our study but Raj *et al.*^[25] have noted increased graft failure with increasing graft size. Preexisting glaucoma and PAS were significant risk factors for developing post-PK glaucoma.^[26,27] There is a 9% cumulative risk with no prior glaucoma versus a 90% cumulative risk for preexisting glaucoma.^[1]

Our study is limited by its retrospective nature. There could be selection bias for the type of surgery done according to the surgeon's preference and small numbers in each group makes subgroup analysis difficult. Both the surgical techniques are different where PK is done mainly for complicated corneal cases, whereas DSEK is indicated for endothelial disorders mainly pseudophakic bullous keratopathy and the likes as in our case study. Since the surgical technique is done by a single surgeon, there can still be variations in practice patterns, hence the results cannot be generalized. Strengths of this study include a variety of complex cases with a multidisciplinary approach in management and long follow-up of cases.

Conclusion

In conclusion, our study showed the moderate success of trabeculectomy in post-DSEK and PK eyes. Prior counseling regarding higher chances of graft failure following trabeculectomy in eyes with multiple prior corneal surgeries should be considered.

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Conflicts of interest

There are no conflicts of interest.

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