

# RESULTS OF POSTERIOR LAMELLAR KERATOPLASTIES IN PHAKIC EYES

Dítě J., Netuková M., Klimešová YM., Křížová D., Studený P.

Department of Ophthalmology of Third Faculty of Medicine,  
Charles University and University Hospital Královské Vinohrady,  
Prague, Czech Republic

*The authors declare no financial or proprietary interest related to this work, and the work has received no funding from any organisation. It was not submitted to or printed in any other journal.*

Received: 15 June 2021

Accepted: 12 November 2021

Available on-line: 5 January 2022



MUDr. Jakub Dítě  
Oftalmologická klinika 3. lékař-  
ské fakulty Univerzity Karlovy  
a Fakultní nemocnice Královské  
Vinohrady  
Šrobárova 1150/50  
Praha 10  
E-mail: jakub.dite@gmail.com

## SUMMARY

**Purpose:** To evaluate the results of posterior lamellar keratoplasties (DMEK and PDEK) in phakic eyes.

**Materials and methods:** Retrospective analysis of surgeries performed in our Department between June 2016 and December 2019. The main focus was on postoperative visual acuity, corneal endothelial cell density and possible perioperative and postoperative complications, including cataract formation.

**Results:** We performed 12 surgeries on 11 eyes of 7 patients. The most prevalent primary diagnosis was Fuchs' endothelial dystrophy (7 eyes), followed by bullous keratopathy after phakic anterior chamber IOL implantation (2 eyes) and ICE syndrome (2 eyes). The average length of follow-up was 12.5 months. Clinically significant complicated cataract had developed and was removed from 3 eyes. One eye required rebubbling due to graft detachment and one eye required rePDEK due to graft failure. At the end of follow-up, the average best corrected visual acuity was 0.87, while 82% of eyes achieved best corrected visual acuity 0.8 or better, and the average endothelial cell density was 1589 cells/mm<sup>2</sup>.

**Conclusion:** Posterior lamellar keratoplasties (DMEK and PDEK) can be performed on phakic eyes. When performed by an experienced surgeon, these are safe procedures with good postoperative results and have a significant advantage in preserving younger patients' accommodation.

Čes. a slov. Oftal., 78, 2022, No.1, p. 20–23

## INTRODUCTION

Since Melles introduced PLK (posterior lamellar keratoplasty) in 1998, posterior lamellar keratoplasties have gradually become the gold standard of surgical treatment of corneal endothelium decompensation. Over time, other procedures, such as DSEK (Descemet's stripping endothelial keratoplasty), DSAEK (Descemet's stripping automated endothelial keratoplasty), DMEK (Descemet's membrane endothelial keratoplasty) and PDEK (pre-Descemet's endothelial keratoplasty) have been introduced [1–6]. Due to the fact that the two most common primary diagnoses leading to corneal endothelium decompensation are Fuchs' endothelial dystrophy, which typically manifests in older patients, and pseudophakic bullous keratopathy [7,8], the significant majority of posterior lamellar keratoplasties are performed on pseudophakic eyes, or as a combined procedure (keratoplasty and cataract surgery) [9,10]. The last and the least common variant is posterior lamellar keratoplasty in phakic eyes, which has a potentially significant

risk of complicated cataract development and may be technically more challenging due to the shallower anterior chamber. However, operating on phakic eyes has unquestionable advantages as well, the most important being the preservation of younger patients' accommodation. Some authors even believe that phakic patients achieve on average better postoperative visual acuity (VA) than pseudophakic patients [11,12].

In this article, we retrospectively evaluate our experiences and results of posterior lamellar keratoplasties (DMEK and PDEK) in phakic eyes.

## MATERIALS AND METHODS

Retrospective analysis of posterior lamellar keratoplasties (DMEK and PDEK) in phakic eyes, performed in the Department of Ophthalmology of the Third Faculty of Medicine, Charles University and the University Hospital Královské Vinohrady, Prague, between June 2016 and December 2019. PDEK procedures were performed until autumn 2017, when we switched to DMEK

as the standard of care. All procedures were performed under local anaesthesia and during a short hospitalisation period (3 days). Standard operation technique was used (no viscomaterial use, main incision 2.2 mm, two side incisions 1.1 mm, Descemet's membrane stripping, graft preparation including staining with trypan blue, scrolled graft implantation, graft unscrolling and fixation by air bubble), but without artificial mydriasis. All corneal grafts were processed and preserved, using hypothermia in the eye tissue bank of the University Hospital Královské Vinohrady. Postoperatively, patients were positioned in a recovery room in the supine position for 1 hour, with subsequent removal of part of the air bubble via paracentesis, using a slit lamp. In our experience, this is enough to prevent pupillary block, as the air bubble no longer blocks the whole pupil. For this reason, iridotomies were not performed. Patients were instructed that further supine positioning was necessary for another 24 hours or until the air bubble was absorbed. To reduce the risk of postoperative infectious or immunological complications, a combination of local 0.3 tobramycin and 0.1 dexamethasone (Tobradex, Alcon, USA) drops were used 5 times a day until finishing the 5 ml bottle. Thereafter, the patients proceeded to use 0.1 dexamethasone (Dexamethasone WZF Polfa, WZF Polfa, Poland) drops, initially 5 times a day with subsequent slow tapering for approximately 6 months.

Our retrospective analysis was focused on the postoperative progression of VA, corneal endothelial cell density (ECD) and possible complications, including complicated cataract formation. VA and ECD were evaluated preoperatively and 3 months, 6 months and 12 months postoperatively. Decimal VA was measured with best possible correction, using projected optotypes NIDEK CP-670 (NIDEK, Tokyo, Japan); ECD was measured using specular microscope NIDEK CEM-530 (NIDEK, Tokyo, Japan).

## RESULTS

During the reported period, 12 posterior lamellar keratoplasties (DMEK and PDEK) were performed on 11 phakic eyes of 7 patients. The list of patients including diagnoses and monitored parameters is recorded in Table 1.

Fuchs' endothelial dystrophy was the most common primary diagnosis (7 eyes), followed by bullous keratopathy secondary to phakic anterior chamber artificial lens (IOL) implantation, that was performed in another eye clinic for refractive reasons (2 eyes), and iridocorneal endothelial (ICE) syndrome (2 eyes). The average patient age was 47 years and the average follow-up length was 12.5 months. The average VA was preoperatively 0.38 and at the end of follow-up 0.87, while 82% of eyes achieved VA of 0.8 or better. Preoperative ECD values could not be measured. At the end of follow-up, the average ECD was 1589 cells/mm<sup>2</sup>, while the average graft ECD was 2852 cells/mm<sup>2</sup>. All average values of monitored parameters are recorded in Table 2.

The only peroperative complication that we recorded was graft dislocation into the ciliary sulcus. The graft was repositioned back into the anterior chamber, using forceps with irrigation support and the surgery was completed without other complications. Two rebubbings, i.e. additional injection of an air bubble into the anterior chamber, were performed postoperatively, due to graft detachment (incidence 16.6%). One was successful, while the other eye required reoperation (rePDEK) due to graft failure. The reoperation was successful, and no other complications occurred. Another recorded postoperative complication was complicated cataract development, which occurred and was surgically resolved in 3 eyes during the first postoperative year (incidence 27%). However, only one of these cataracts formed after simple posterior lamellar keratoplasty (incidence 11.1%). The other two cases were both eyes of a patient with bilateral endothelium decompensation secondary to phakic anterior chamber IOL implantation. In this patient,

**Table 1.** List of patients and monitored parameters

age	dg.	operation	entry VA	final VA	graft ECD	final ECD	complications
61	ICE	PDEK	0.2p	0.5	2907	1081	decompensation of glaucoma, cataract
39	FED	PDEK	0.7p	1.2	3077	1419	
55	FED	PDEK	0.5p	0.8	2865	775	rebubbling
39	FED	PDEK	0.6p	1.0p	2833	1712	graft dislocation in sulcus, rebubbling, rePDEK
55	FED	DMEK	0.5p	1.0p	3205	1125	
42	ICE	DMEK	0.4p	0.5	2882	2872	
43	FED	DMEK	0.4	1.0p	2532	1579	
46	BK	DMEK	CF	1.0p	2770	1307	AC IOL explantation, cataract
46	BK	DMEK	0.1	0.9p	2841	928	AC IOL explantation, cataract
44	FED	DMEK	0.5p	1.0p	2564	2132	
47	FED	DMEK	0.7p	1.0p	2688	2031	

dg. – diagnosis, VA – visual acuity (decimal), ECD – endothelial cell density (cell/mm<sup>2</sup>), ICE – iridocorneal endothelial syndrome, FED – Fuchs' endothelial dystrophy, BK – bullous keratopathy, CF – counts fingers, AC IOL – anterior chamber intraocular lens

**Table 2.** Average values of monitored parameters

	preoperative	3M postoperative	6M postoperative	end of follow-up
average VA	0,39	0,70	0,71	0,87
average ECD	2852 (lamela)	1711	1690	1589

VA – visual acuity (decimal), ECD – endothelial cell density (cell/mm<sup>2</sup>), 3M – 3 months, 6M – 6 months

keratoplasty was combined with IOL explantation. The last postoperative complication was decompensation of primary open angle glaucoma in one eye, requiring increased local antiglaucoma therapy (incidence 9.1%).

## DISCUSSION

Our final VA and ECD results, i.e. average VA 0.87 and 82% of eyes with VA 0.8 or better and average ECD 1589 cells/mm<sup>2</sup>, are comparable with other authors' works. Heinzelmann described 53% of eyes with VA 0.8 or better, 24 months after the surgery, in his analysis of over 450 DMEK operations [7]. Droutsas published the results of 100 DMEK operations with 65% of eyes with VA 0.8 or better, and average ECD 1730 cells/mm<sup>2</sup>, 6 months after the surgery [9]. Studies by Burkhart (49, operations, 12 months follow-up) and Parker (52 operations, 6 months follow-up), with all operations performed on phakic eyes, reported 92% (Burkhart) and 85% (Parker) of eyes with VA 0.8 or better, and median ECD 2153 (Burkhart) and 1660 (Parker) cells/mm<sup>2</sup> at the end of follow-up [11,13]. These results give the impression that postoperative VA is in general better in studies that describe only phakic posterior lamellar keratoplasties (Burkhart, Parker, our Department), compared to those that describe all types of posterior lamellar keratoplasties, where pseudophakic eyes are a significant majority (Heinzelmann, Droutsas) [7,9,11,13]. Parker and Gundlach came to similar conclusions in their works [11,12]. However, we cannot draw a conclusion that postoperative VA of phakic eyes is generally better than postoperative VA of pseudophakic eyes. based only on these results, because posterior lamellar keratoplasties in phakic eyes are on average performed on younger patients.

Concerning complications, the 27% incidence of complicated cataract requiring surgery during one year of follow-up in our cohort was negatively affected by the fact that one patient required explantation of the phakic anterior chamber IOL to be performed during posterior lamellar keratoplasty in both of his eyes. The presence and necessity to explant the IOLs contributed to complicated cataract development, and both eyes of this patient required cataract removal during one year of follow-up. When we rated only complicated cataracts following simple posterior lamellar keratoplasty without IOL explantation, 11.1% incidence was recorded. Due to the lower average age of patients in our cohort (47 years) and after studying previously published works, this is an expected value. Gundlach reported 13% incidence

of complicated cataract in the first year after the surgery [12]. Price recorded 0% incidence of complicated cataract in the first year and 7% in three years after the surgery in her cohort of DSEK patients under 50 years of age. However, the values were much higher with 31% incidence of complicated cataract in the first year and 55% in three years after the surgery in patients over 50 years of age [14]. Burkhart reported a 33% incidence of this complication in the first year after the surgery, and just as in the case of Price's work, the risk of complicated cataract formation was strongly linked to higher age [13]. In general, higher age is repeatedly mentioned as a very significant risk factor for the development of complicated cataract after posterior lamellar keratoplasty [13–15]. This was also confirmed by our results, because the only case of complicated cataract in the first year after simple posterior lamellar keratoplasty was recorded in a 61-year-old patient, who was the oldest in our group.

Our rebubbling rate of 16.6% is a good result compared to other published works. Siebelmann (1541 surgeries), Dunker (752 surgeries), and Gundlach (463 surgeries) reported rebubbling rates of 32.4%, 19%, and 35.2%, respectively [8,16,17]. In general, the influence of phakia, pseudophakia or a combined procedure (keratoplasty and cataract surgery) on postoperative graft detachment rates is often mentioned in the literature. A possible positive effect of phakia was described in the past [10], but the negative effect of a combined procedure was recorded most often [12,18]. One of the possible reasons may be leaving part of viscoelastic material in the anterior chamber, which could mechanically prevent complete graft attachment. However, these opinions are not supported by the results of Siebelmann and Dunker, as neither of them proved any statistically significant difference in rebubbling rates in eyes that are phakic, pseudophakic or undergoing a combined procedure [8,16].

Another complication that we recorded was one unsuccessful rebubbling, requiring subsequent graft replacement (rePDEK). This situation occurred in the eye that suffered a peroperative complication, when the graft was dislocated into the ciliary sulcus and repositioned back into the anterior chamber using forceps. In our opinion, this case of graft failure was most probably caused by mechanical traumatization of the graft during manipulation. Due to the absence of artificial mydriasis, which is meant to reduce the risk of complicated cataract development, this type of complication is much rarer in phakic eyes, compared to pseudophakic. However, its management is more demanding, because of the lens presence.

## CONCLUSION

The statistical relevance of our results is limited by the size of our sample, which is caused by the fact that phakic posterior lamellar keratoplasty is a relatively rare procedure. However, we did manage to confirm that posterior lamellar keratoplasties (DMEK and PDEK) can be safely performed on phakic eyes, and when performed by an experienced surgeon, the results are very good. Some authors even believe that phakic patients on average achieve better postoperative VA than pseudophakic patients [11,12]. However, this finding is at least in part caused by the lower average age of patients undergoing phakic posterior lamellar keratoplasty. From the perspective of a surgical technique and based on our experience,

Descemet's membrane stripping is easier in pseudophakic eyes, while graft unscrolling in the anterior chamber is easier in phakic eyes. Both these differences are caused by a shallower anterior chamber in phakic eyes.

The most important advantage of operating on phakic eyes remains the preservation of younger patients' accommodation. Due to this advantage and the fact that the risk of complicated cataract development is significantly influenced by patient's age [13–15], we recommend taking the patient's age into account as one of the main criteria in deciding whether to indicate posterior lamellar keratoplasty in a phakic eye, or a combined procedure (cataract surgery and keratoplasty) straight away. Both lens status and the patient's preference must of course be taken into account as well.

## REFERENCES

1. Melles GRJ, Eggink FA, Lander F et al. A surgical technique for posterior lamellar keratoplasty. *Cornea*. 1998 Nov;17(6):618-626.
2. Price FW, Price MO. Descemet's stripping with endothelial keratoplasty in 50 eyes: a refractive neutral corneal transplant. *J Refract Surg*. 2005 Aug;21(4):339-345.
3. Gorovoy MS. Descemet-Stripping Automated Endothelial Keratoplasty. *Cornea*. 2006 Sep;25(8):886-889.
4. Melles GRJ. DLEK to DSEK to DMEK. *Cornea*. 2006 Sep;25(8):879-881.
5. Melles GRJ, Ong TS, Ververs B, van der Wees J. Preliminary Clinical Results of Descemet Membrane Endothelial Keratoplasty. *Am J Ophthalmol*. 2008 Feb;145(2):222-227.
6. Agarwal A, Dua HS, Narang P et al. Pre-Descemet's endothelial keratoplasty (PDEK). *Br J Ophthalmol*. 2014 Sep;98(9):1181-1185.
7. Heinzelmann S, Böhringer D, Eberwein P, Reinhard T, Maier P. Outcomes of Descemet membrane endothelial keratoplasty, Descemet stripping automated endothelial keratoplasty and penetrating keratoplasty from a single centre study. *Graefes Arch Clin Exp Ophthalmol*. 2016 Mar;254(3):515-522.
8. Dunker S, Winkens B, van den Biggelaar F, Nuijts R, Kruit PJ, Dickman M. Rebubbling and graft failure in Descemet membrane endothelial keratoplasty: a prospective Dutch registry study. *Br J Ophthalmol*. 2021 Feb 17;0:1-7.
9. Droustas K, Ham L, Dapena I, Geerling G, Oellerich S, Melles G. Visus nach Descemet-Membran Endothelkeratoplastik (DMEK): Ergebnisse der ersten 100 Eingriffe bei Fuchs'scher Endotheldystrophie. *Klin Monatsblätter Für Augenheilkd*. 2010 Jun;227(06):467-477.
10. Siebelmann S, Ramos SL, Matthaei M et al. Factors Associated With Early Graft Detachment in Primary Descemet Membrane Endothelial Keratoplasty. *Am J Ophthalmol*. 2018 Aug;192:249-250.
11. Parker J, Dirisamer M, Naveiras M et al. Outcomes of Descemet membrane endothelial keratoplasty in phakic eyes. *J Cataract Refract Surg*. 2012 May;38(5):871-877.
12. Gundlach E, Maier AKB, Tsangaridou MA et al. DMEK in phakic eyes: targeted therapy or highway to cataract surgery? *Graefes Arch Clin Exp Ophthalmol*. 2015 Jun;253(6):909-914.
13. Burkhart ZN, Feng MT, Price FW, Price MO. One-year outcomes in eyes remaining phakic after Descemet membrane endothelial keratoplasty. *J Cataract Refract Surg*. 2014 Mar;40(3):430-434.
14. Price MO, Price DA, Fairchild KM, Price FW. Rate and risk factors for cataract formation and extraction after Descemet stripping endothelial keratoplasty. *Br J Ophthalmol*. 2010 Nov 1;94(11):1468-1471.
15. Trindade BLC, Eliazar GC. Descemet membrane endothelial keratoplasty (DMEK): an update on safety, efficacy and patient selection. *Clin Ophthalmol*. 2019 Aug;13:1549-1557.
16. Siebelmann S, Kolb K, Scholz P et al. The Cologne rebubbling study: a reappraisal of 624 rebubbings after Descemet membrane endothelial keratoplasty. *Br J Ophthalmol*. 2020 Aug 17;0:1-5.
17. Gundlach E, Pilger D, Dietrich-Ntoukas T, Jousen AM, Torun N, Maier A-KB. Impact of Re-bubbling after Descemet Membrane Endothelial Keratoplasty on Long-term Results. *Curr Eye Res*. 2021 Jun 3;46(6):784-788.
18. Leon P, Parekh M, Nahum Y et al. Factors Associated With Early Graft Detachment in Primary Descemet Membrane Endothelial Keratoplasty. *Am J Ophthalmol*. 2018 Mar;187:117-124.