

Effect of the position of the corneal lamella on the frequency of its detachment

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Abstract

• **AIM:** To determine the influence of gaps [places where neither the donor's nor the recipient's Descemet's membrane (DM) is present] and overlaps (places where the recipient's DM is covered by the donor's DM) on the frequency of postoperative detachment of DM endothelial keratoplasty (DMEK) lamellae.

• **METHODS:** Totally 64 eyes of 64 patients with Fuchs' endothelial dystrophy or bullous keratopathy indicated for DMEK were randomly divided in two groups. The diameter of the implanted DMEK lamella was the same in both groups (8 mm), but we changed the diameter of the removed recipient DM. In the first group (32 eyes), the circular area was approximately 8.5 mm (gaps); in the second group (32 eyes), the diameter was 7.5 mm (overlaps). Postoperatively we noted all cases of detachment visible on the slit lamp and these cases we indicated for rebubbling. We also measured the uncorrected distance visual acuity (UDVA) as well as corrected distance visual acuity (CDVA) in decimal and postoperative endothelial cell density (ECD). The minimum follow-up time was 6mo.

• **RESULTS:** The number of rebubbling procedures in the entire group of patients was 13, *i.e.*, 20.3%, with 6 eyes (18.7%) in the gap group, and 7 eyes (21.9%) in the overlap group. Lamella replacement (re-DMEK) was required in 3 (gap group) and 2 patients (overlap group), respectively. The difference between the groups was statistically insignificant. The UDVA was 0.54 ± 0.21 in the gap group and 0.58 ± 0.24 in the overlap group. The CDVA was 0.74 ± 0.22 and 0.80 ± 0.16 , respectively. ECD was 1920 ± 491 and 2149 ± 570 cells/mm². The small differences between both groups were not statistically significant.

• **CONCLUSION:** We do not notice any difference in the group of patients with overlaps or gaps of DM. The presence of small areas of gaps or overlaps does not affect the frequency of detachment of the DMEK lamellae.

• **KEYWORDS:** centrally positioned Descemet graft; Descemet graft detachment; Descemet membrane endothelial keratoplasty; posterior lamellar keratoplasty; recovery of corneal transparency

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INTRODUCTION

Endothelial keratoplasty (EK) is currently considered the standard procedure in the treatment of dysfunctional corneal endothelium. Compared with penetrating keratoplasty, EK provides faster and more reliable visual rehabilitation while maintaining the eye's structural integrity^[1-2]. Modern EK procedures have undergone rapid evolution with refinements in technique^[3-4]. Three procedures are the most common, namely, Descemet's stripping automated EK-DSAEK [transplanted lamella consists of the endothelium, Descemet's membrane (DM), and deep layers of the stroma]^[5], DMEK (eliminates the donor stromal layer)^[6-7], and pre-DMEK (PDEK; in comparison with DMEK, the so-called Dua layer is also included, a thin pre-Descemet's collagen layer without corneal cells)^[8-10].

Although more surgically challenging than other EK techniques, DMEK provides even faster visual rehabilitation and reduced risk of immunologic rejection in comparison with DSAEK, so it has been used increasingly^[11-13]. The most frequent complication after surgery is partial or total detachment of the lamellae and the need of reattachment using an air bubble (rebubbling)^[14]. Usually, the reported frequency of detachment is between 10% and 30%^[15-17]. In their review of 47 works, Deng *et al*^[18] state a mean detachment frequency of 28.8%, in the range of 0.2%-76%.

Detachment can appear either as peripheral graft edge nonadherence or as a more extensive defect. DMEK lamella

detachment is less likely to resolve spontaneously due to the graft's tendency to roll up. Detachment of the central cornea or those involving more than one-third of the graft may require rebubbling, which is often successful but may result in decreased endothelial cell density (ECD). If there is total detachment or the graft has rolled up, the patient may need re-grafting^[19]. The causes of detachment are less clear, with potential risk factors including recipient age^[20], surgical complications^[21], triple procedure (DMEK+cataract surgery+intraocular lens implantation)^[21-22], detachment of the lamellae in the first eye^[22-23], using lamellae prepared in tissue bank^[22], decentration of the lamellae^[24], incomplete removal of the recipient DM and disruption of posterior stromal layers^[25]. On the contrary, other factors were found to be insignificant—age of recipient, sex of recipient and donor, time between donor death and processing, and respective tissue transplantation^[26-27].

Perfect adaptation of the edges of the donor lamella and the removed lamella is often not surgically possible. Therefore, very often there are areas where DM is missing (gap) and areas where the donor and recipient DM overlap.

The aim of our study was to determine whether the presence of gaps or overlaps affects the frequency of detachment of the DMEK lamellae.

SUBJECTS AND METHODS

Ethical Approval The study protocol was approved by the institutional review board of the University Hospital Kralovske Vinohrady and was in accordance with the tenets of the Declaration of Helsinki. All patients signed informed consent. It was a prospective randomised study. Totally 64 eyes of 64 patients with Fuchs' endothelial dystrophy or bullous keratopathy indicated for DMEK were randomly divided in two groups. In the first group, the diameter of the circular area of removed DM on the recipient cornea was approximately 8.5 mm, in the second group the diameter was 7.5 mm. The diameter of the implanted DMEK lamella was routinely 8 mm. Due to the fact that in the first group (Overlaps) the removed part of DM was smaller than the implanted lamellae, there were always areas with both DM (recipient's as well as donor's). On the contrary, in the second group (Gaps), where the denuded part was always larger than the transplanted lamella, there were areas with exposed stroma without DM. The area of DM removed thus differed quite significantly between the two groups. While in the case of the 7.5 mm diameter, the exposed area is about 44.18 mm² ($A=\pi r^2$), the area of the 8.5 mm disk is 56.75 mm², so it was 28% larger. In contrast, the donor DM had a standard area of 50.27 mm² in both groups.

All surgeries were done under topical anesthesia by one experienced surgeon (Studený P). The size of the planned

descemetorhexis was marked on the corneal epithelial surface using a stained blunt marker. A main corneal incision of 2.2 mm was made at 12 o'clock and two paracenteses at 3 and 9 o'clock. Descemetorhexis and then descemetostripping was performed with a sharp and blunt scraper, and the anterior chamber was maintained with an irrigation cannula inserted in the paracentesis. We did not use any viscoelastic material. The lamellae were prestripped in our tissue bank (OTB 1, Prague, Czech Republic), all donors were older than 50, and the minimal ECD after preparation was 2500 cells/mm². We used our own technique of hydroimplantation, where the DMEK lamella is inserted in a plastic cartridge connected to a syringe filled with (BSS). A stream of water brought the lamella into the anterior chamber, which was subsequently unrolled by irrigation and aspiration cannulas and fixed to the recipient's cornea by an air bubble. The patient was then positioned for 1h, after which a part of the air bubble from the anterior chamber was released on the slit lamp through the paracentesis to prevent a pupillary block. All patients with any complications during surgery we excluded from the study.

After surgery, we evaluated the patients every 2wk for the first 2mo, after that once a month. We noted all cases of detachment visible on the slit lamp and these cases were indicated for rebubbling. We also measured the uncorrected (UDVA) as well as corrected distance visual acuity (CDVA) in decimal and postoperative ECD. The minimum follow-up time was 6mo.

RESULTS

The gap group included 32 eyes of 32 patients, the mean age was 73.2±8.0y (min 60, max 93), the overlap group included 32 eyes of 32 patients, the mean age was 68.8±9.8y (min 44, max 88). Despite the fact that it was a random sampling, the average age in both groups was slightly different (the average age in the gap group was higher) and this difference was at the margin of statistical significance ($P=0.05003$). The results are summarized in Table 1. The number of rebubbling interventions in the entire group of patients was 13, *i.e.*, 20.3%, 6 eyes (18.8%) in the gap group and 7 eyes (21.9%) in the overlap group. Lamella replacement (re-DMEK) was required in 3 (gap group) and 2 patients (overlap group), respectively. All the cases indicated for re-transplantation had partial detachment of the lamellae, they were indicated for rebubbling at first, which was unsuccessful. They are also included in the number of rebubbling interventions. Small differences in the number of rebubbling, UDVA, CDVA, and ECD procedures between the groups were statistically insignificant.

In these two smaller groups of patients, we did not notice any statistically significant difference in UDVA, CDVA, or ECD.

Table 1 Summary of results, 6mo after surgery, gap and overlap group

Lamella position	UDVA	CDVA	ECD (cells/mm ²)	Rebubbling	Re-DMEK
Gap	0.54±0.21	0.74±0.22	1920±491	6 (18.7%)	3 (9.4%)
Overlap	0.58±0.24	0.80±0.16	2149±570	7 (21.9%)	2 (6.3%)

UDVA: Uncorrected distance visual acuity; CDVA: Corrected distance visual acuity; ECD: Endothelial cell density; DMEK: Descemet's membrane endothelial keratoplasty.

DISCUSSION

Detachment of the transplanted lamella is the most common postoperative complication after DMEK. The average frequency varies considerably in the literature (0.2%-76%). Although it has been reported that possible rebubbling does not affect postoperative outcomes^[21], lamella detachment and necessary rebubbling are generally considered undesirable postoperative complications. A number of authors have tried to identify the risk factors leading to postoperative lamella detachment. It has been found that, for example, combined DMEK and cataract surgery, complications during surgery, posterior stromal layer rupture, lower endothelial cell count, density of the graft, *etc.* affect the increased frequency of detachment^[20-22,26].

Nevertheless, they probably do not represent all causes, as even after taking them into account, the problem of postoperative detachment of the lamella is not eliminated. Some authors consider optimal lamella centration^[24,26] to be important. Brockman *et al*^[25] investigated intraoperatively obtained recipients' DM histologically and immunohistochemically. Separation and disruption of the anterior banded layer (ABL) were frequently observed in patients with graft detachment, and ABL thickness was identified as a significant predictor for graft detachment. In their study, the ABL thickness was 2.5±0.9 µm and 3.5±1.6 µm in patients with attached and detached grafts, respectively. In contrast, a complete DM removal with residual stromal collagen fragments was observed in patients with adherent grafts^[25].

On the contrary, this is evidenced by the fact that some authors describe a successful DMEK by completely leaving the affected DM in the recipient's eye and covering this by a donor DM layer. This procedure is described mainly in the case of endothelial failure treatment in patients after previous perforating keratoplasty, where removal of DM from the transplanted cornea is difficult and could lead to disruption of the posterior surface of the original graft. These authors did not report an increased incidence of lamella detachment in these cases^[28-29].

Due to the fact that perfect adaptation of the edges of the donor lamella and the left DM of the recipient is technically difficult or impossible, there are almost always areas where both DMs (donor and recipient) overlap and places where the DM is completely missing and the cornea is separated from the anterior chamber fluid only by the posterior surface of the corneal stroma, or by the Dua's layer^[8].

The frequency of detachment in our entire group of patients was comparable to the average reported in the literature

(20.3%). Nevertheless, it was higher than stated by some authors. This fact is undoubtedly related to the different approaches of individual authors to the evaluation of the detachment size and the different indications for rebubbling^[30]. This approach varies greatly from author to author. We noted all cases of detachment visible on the slit lamp and these cases we indicated for rebubbling.

Nevertheless, both of our groups differed only in the size of the removed lamella. We did not consider the effect of the slightly different average age of the two groups to be significant on the outcome of the surgery.

Given that the surgical technique and evaluation methodology used were identical in both of our groups, it is clear that in our group of patients, the size of the lamella removed from the recipient's cornea had no effect on the frequency of detachment. Since in the group where the removed lamella was smaller than the donor lamella, there were indiscriminate overlap sites, and in the group where the removed lamella was larger than the donor lamella there were DM gaps. This was the only difference between the groups, from which it can be concluded that the presence of a gap or overlap does not affect the frequency of lamella detachment.

In conclusion, we did not notice any difference in the group of patients with overlaps or gaps of DM. The presence of small areas of gaps or overlaps does not affect the frequency of detachment of the DMEK lamellae.

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