Surgical Technique for Graft Exchange After Big-Bubble Deep Anterior Lamellar Keratoplasty

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Purpose: The aim of this study was to describe a surgical technique for repeat deep anterior lamellar keratoplasty (DALK) by baring Descemet membrane again in eyes affected by stromal opacity of the donor lamella.

Methods: Repeat DALK was performed in 5 eyes of 5 patients affected by central stromal opacity not involving the endothelium; indications for repeat surgery were postbacterial or postherpetic corneal scars (n = 3), postphotorefractive keratectomy haze (n = 1), and recurrence of granular dystrophy (n = 1). The surgical procedure consisted of the following: (1) superficial trephination, 250 μm in depth, on the original peripheral scar; (2) blunt detachment of the donor graft completed by means of corneal forceps; (3) apposition of the new lamella. Best spectacle-corrected visual acuity, topographic astigmatism, and endothelial cell density were evaluated preoperatively, as well as 3, 6, 9, 12, and 18 months after surgery.

Results: At the latest follow-up examination, with all sutures removed from all eyes, the best spectacle-corrected visual acuity was 20/30 or better in all cases with 3 eyes achieving 20/20. Postoperative refractive astigmatism averaged 3.0 ± 1.2 diopters (mean ± SD); endothelial cell density was not significantly affected by surgery.

Conclusions: Repeat DALK is effective in removing diseased corneal stroma while keeping the recipient endothelium unaffected; the procedure is simple and does not require pneumatic dissection, thus eliminating the most challenging surgical step; postoperative visual recovery does not differ from that experienced after primary DALK.

Key Words: anterior lamellar keratoplasty, graft exchange, repeat DALK, big-bubble DALK

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Visual results after deep anterior lamellar keratoplasty (DALK) may be limited by several postoperative complications affecting stromal clarity, such as recurrence of corneal dystrophies, and postinfectious scars or haze after photorefractive keratectomy performed for correction of unsatisfactory refractive results.[1–4] Not different from the primary indication, the goal of surgery in these cases should be limited to replacement of diseased stroma, thus again sparing the healthy recipient endothelium.

Uneventful graft exchange after big-bubble DALK is theoretically possible, but to date has been described sporadically.[5,6] In particular, the surgical scar of the previous procedure, as well as adherence between donor tissue and the recipient bed may be critical issues for successful repeat DALK, especially if it is performed months or years later. However, to the best of our knowledge, no technique for repeat DALK has yet been published. We describe a surgical technique for baring Descemet membrane (DM) again and performing DALK in eyes requiring repeat surgery.

MATERIALS AND METHODS

After obtaining approval from the institutional review board, medical records of every patient who underwent repeat DALK at our institution (University of "Magna Graecia," Department of Ophthalmology, Catanzaro, Italy) between 1 January 2010 and 31 January 2013 were reviewed retrospectively. The study followed the tenets of the 1964 Declaration of Helsinki, and detailed informed consent was signed by all patients.

Uncorrected visual acuity and best spectacle-corrected visual acuity, endothelial cell density (ECD) (cornea module of HRT-II; Heidelberg Technology, Heidelberg, Germany), and corneal topography together with anterior segment optical coherence tomography (AS-OCT, SS-1000 CASIA; Tomey, Japan) were assessed preoperatively, as well as 3, 6, 9, 12, and 18 months postoperatively. The attempt at repeating DALK was made independent of the preoperative findings, that is of the scar depth. A Student *t* test was used to evaluate statistical significance of the changes recorded ($P < 0.05$ was considered significant).

Surgical Technique

In all patients, anesthesia was obtained with peribulbar injection of a mixture of 5 mL each of lidocaine 2% and bupivacaine 0.5%. Initially, a caliper was used to measure the diameter of the old graft (see Video, Supplemental Digital

Content 1, http://links.lww.com/ICO/A261, which illustrates all the steps of the surgical technique). A same size Barron suction trephine (Katena Products Inc, Denville, NJ) was centered on the circular scar of the previous DALK and advanced to a depth of about 250 μm, with the purpose of partially reopening the wound (Fig. 1A). Two toothed corneal forceps were used to grasp the edges of the wound and pull them apart, thus deepening the gape up to completion of the dehiscence, which was signaled by the appearance of the smooth surface of the recipient bed of previous DALK (Figs. 1B, C). Blunt detachment of the donor graft from the recipient edge was completed for 360 degrees in all cases without using any cutting device (Figs. 1D, E). Except for the vertical scar, no adherence was found in any case between donor tissue and the recipient bed of previous DALK.

A Barron donor punch (Katena Products Inc) was used to prepare a full-thickness graft, 8 to 8.3 mm in diameter (same size as trephination in the recipient cornea), from which DM and the endothelium were stripped off using a dry Weck-Cel sponge. After removal of the donor tissue of the old DALK, initially, the new donor button was fixated into the recipient bed with 4 cardinal stitches, and wound closure was completed with two 16-bite double running 10-0 nylon sutures (Fig. 1F) that were removed in all cases between 12 and 18 months after surgery.

RESULTS

Five eyes of 5 patients who had undergone late exchange of a big-bubble DALK graft were identified. Repeat DALK was performed between 2 and 4 years after primary surgery; indications included postbacterial or postherpetic corneal scars (n = 3), postphotorefractive keratectomy haze (n = 1), and recurrence of granular dystrophy (n = 1). Repeat DALK surgery was uneventful in all cases, requiring no conversion to penetrating keratoplasty (PK); clinical outcome of repeated DALK in the eye affected by recurrence of herpetic infection is showed in Figure 2.

Demographic data and results are summarized in Table 1. At the latest follow-up examination, with all sutures removed from all eyes, the BCVA was 20/30 or better in all cases with 3 eyes achieving 20/20. Postoperative refractive astigmatism averaged 3.0 ± 1.2 diopters (mean ± SD); ECD was not significantly affected by surgery.

DISCUSSION

The main benefit of DALK is exclusive replacement of diseased stroma, thus eliminating the risk of endothelial immunologic rejection.[7] Nevertheless, post-DALK eyes may require graft exchange because of the occurrence of post-operative complications affecting transparency of the transplanted lamella.

Although other surgical alternatives have been proposed to restore corneal clarity in these eyes (ie, PK, microkeratome-assisted lamellar keratoplasty, photorefractive therapeutic keratectomy),[4,8] at least theoretically, only a graft exchange would offer the same advantages of primary DALK.

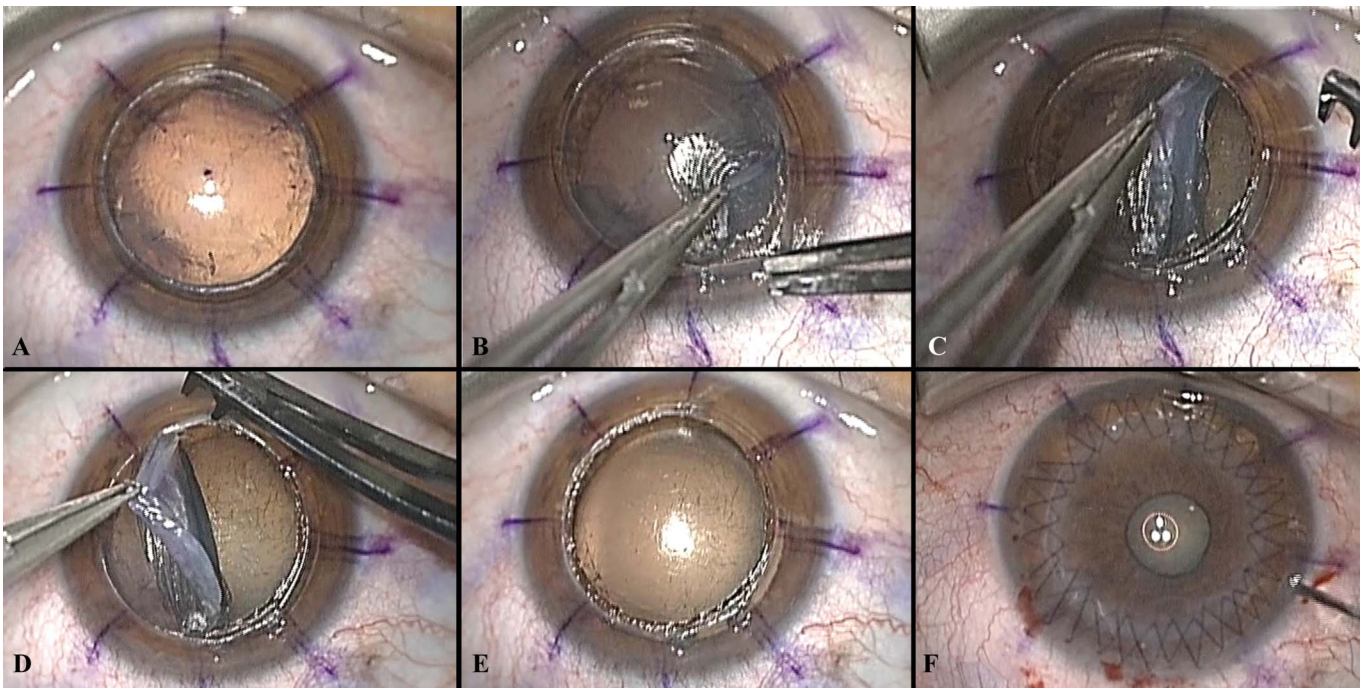

FIGURE 1. Postherpetic scar in the central cornea of an eye undergoing repeat DALK. A, Partial trephination, 250 μm in depth, is centered on the annular scar of previous DALK. B, Corneal forceps are used to reopen the vertical wound and reach the corneal interface. C and D, The anterior lamella is progressively detached from the recipient bed. E, Descemet membrane is totally exposed. F, The new graft is sutured in place with two 16-bite 10-0 nylon running sutures.

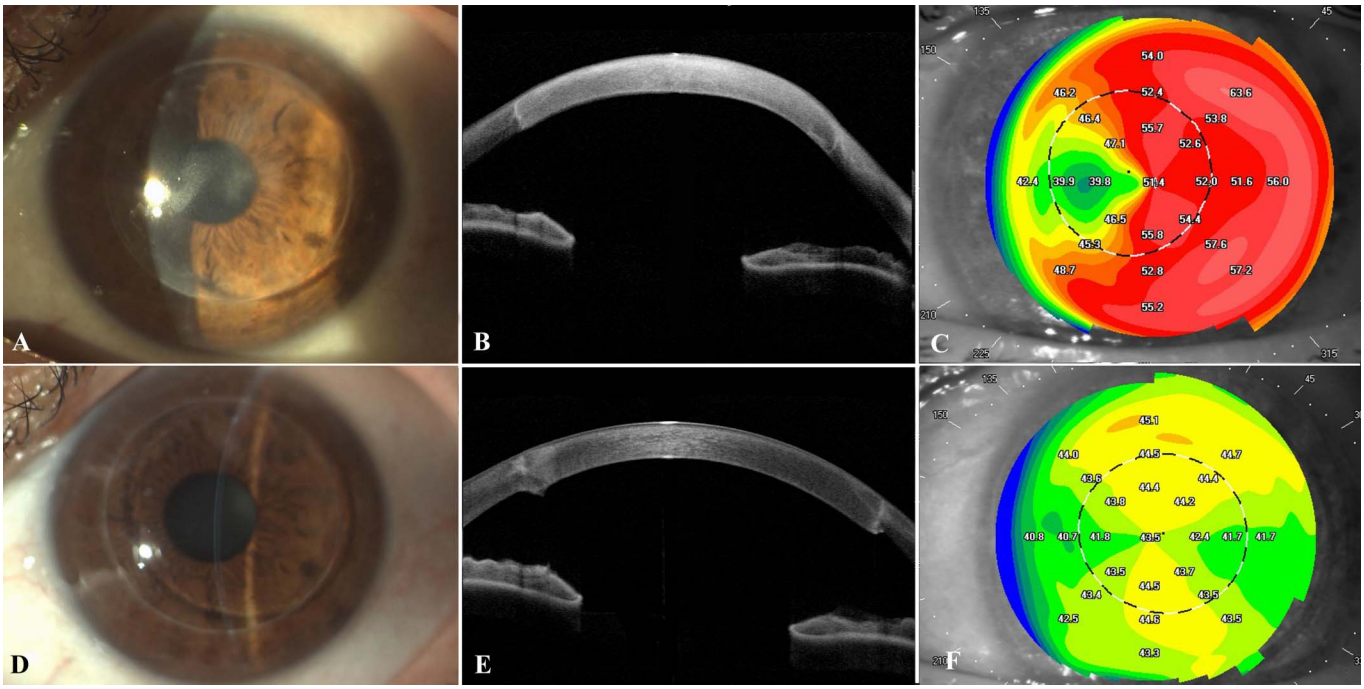

FIGURE 2. A, Preoperative slit-lamp appearance of an eye with recurrence of herpetic infection after big-bubble DALK. B, Anterior segment optical coherence tomography is used to evaluate the depth of stromal opacity and (C) the resulting high-degree irregular astigmatism. D and E, Twenty months after repeat DALK, the cornea is perfectly clear and corneal topography (F) shows the presence of low-degree regular astigmatism.

Recently, Harding et al[5] have shown that in a child with macular dystrophy, the DALK graft could be easily separated from the residual recipient bed and exchanged for a new one. However, to date, no detailed article has been published describing the technique required to effectively and safely reexpose DM as late as 4 years after DALK.

In all eyes of this series, the main challenge was to open the scar of the initial DALK. To facilitate this maneuver, we have used partial thickness trephination, which allowed easy separation of the wound edges, which could then be grasped and further detached from each other up to the interface between donor tissue and the recipient bed. Suction is applied outside the host–graft junction, thus allowing easy centration of the Barron trephine even in the presence of surface irregularities. As an alternative, the annular scar could be scored superficially and the wound dissected manually up to a depth similar to the one reached in our procedure with trephination. However, we feared that this approach might have produced uneven wound margins, thus affecting postoperative corneal curvature and resulting in irregular astigmatism.

As opposed to what we could have anticipated, after severing the vertical wound for 360 degrees, no resistance was encountered while lifting the graft from the surface of the residual recipient bed of the first DALK. As also shown in the attached video, no adherence was present between the 2

TABLE 1. Preoperative and Postoperative Data for Patients Undergoing Repeat DALK

Patient	Age/Sex	Indication for Initial Surgery	Indication for Repeat DALK	Time Elapsed Between First and Second DALK	BSCVA I	BSCVA II	ECD I	ECD II	T Cyl I	T Cyl II	FU
1	46/female	Granular dystrophy	Recurrence of dystrophy	48 mo	20/80	20/20	2130	2115	4.3	3.2	20
2	51/male	Keratoconus	Postinfective scar	30 mo	20/200	20/30	2386	2410	2.1	4.5	18
3	32/male	Keratoconus	Post-PRK scar	40 mo	20/100	20/20	2552	2497	8.5	1.5	20
4	46/female	Postherpetic scar	Recurrence of herpetic infection	25 mo	20/200	20/20	1985	1886	10.2	2.1	36
5	52/male	Keratoconus	Postinfective scar	27 mo	20/200	20/25	2228	2258	7.3	3.7	40

BSCVA, best spectacle-corrected visual acuity; FU, follow-up after repeat DALK; PRK, photorefractive keratectomy; T Cyl, topographic cylinder (diopters); I, preoperative; II, postoperative.

corneal layers, and the interface had maintained a virtual space over a period of as long as 4 years. This finding definitely rules out the necessity for renewed pneumatic[9] or other types of dissection[10] when facing the challenge of repeat DALK, thus eliminating the risk of rupturing the predescemetic/descemetic layer or creating a second plane of dissection at a different level.

Recent research has shown that a thin layer of posterior stroma remains attached to DM in most cases of pneumatic dissection, making the residual bed substantially stronger.[11] As no detail was available regarding the first DALK surgery, we cannot establish whether our technique for graft exchange may be used regardless of the presence or absence of posterior residual stroma in the recipient bed.

ECD was not affected by repeat surgery, making our procedure suitable for all cases of poor visual outcome after a first DALK, including also eyes with clear stroma but low preoperative endothelial density in the presence of post-DALK high-degree and/or irregular astigmatism.[12] Also, although to date, this was not necessary in our patients, our findings support the possibility that DALK may be repeated even more than once without affecting endothelial survival, adding therefore an additional substantial advantage of this procedure over PK.

In conclusion, repeat DALK is effective in removing diseased corneal stroma while keeping the recipient endothelium unaffected; the procedure is simple and does not require pneumatic dissection, thus eliminating the most challenging surgical step; postoperative visual recovery does not differ from that experienced after primary DALK.

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