Slit-lamp technique of draining interface fluid following Descemet's stripping endothelial keratoplasty

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Aim: To describe a new slit-lamp technique for draining interface fluid to manage complete donor disc detachments following Descemet's stripping (automated) endothelial keratoplasty (DSEK/DSAEK).

Methods: Interventional case series. Five DSEK/DSAEK patients presented on the first postoperative day with complete detachment of the donor lenticule. Slit-lamp biomicroscopy showed interface fluid preventing attachment of the donor disc to the host stromal bed. A new slit-lamp technique is described to drain the interface fluid. This technique involved completely filling the anterior chamber with an air bubble using a 30-gauge needle on a 3 ml syringe. Following this, a 0.12 forceps was used to open the inferior mid-peripheral corneal drainage slit to drain the interface fluid.

Results: This technique was successful in draining the interface fluid in all five patients, leading to immediate complete reattachment of the donor disc.

Conclusion: Donor disc detachments following DSEK/DSAEK can be successfully managed by this slit-lamp technique of draining the interface fluid.

The principle of corneal lamellar surgery is to be minimally invasive by selectively replacing the affected layers. Although the concept and first human lamellar corneal transplantation dates back to the late 19th century,¹ it was not until the last and the early part of this decade that rapid and exciting advances have been made in endothelial replacement surgery.^{2–10} Selective endothelial replacement surgery for endothelial dysfunction has been shown to provide rapid postoperative healing, stable and predictable corneal power and early refractive stability.^{5–9, 11}

As the surgical steps and techniques evolve, the nomenclature continues to change. Melles *et al*² coined the term posterior lamellar keratoplasty (PLK), where they used a large 9 mm incision to excise the posterior stroma and the diseased endothelium and replaced it with a donor lenticule consisting of posterior stroma and healthy endothelium. They manually dissected to split the donor and recipient cornea at 80–90% stromal depth. Later Melles⁴ demonstrated that the donor lenticule could be safely folded with an ophthalmic viscosurgical device (OVD) sandwiching the folded lenticule and inserting through a 5.0 mm scleral tunnel incision. Terry *et al*¹² coined the term deep lamellar endothelial keratoplasty (DLEK) that followed the principles of PLK with modifications in the instrumentation and in the introduction of OVD for stromal dissection in the recipient cornea.

Melles⁶ subsequently reported a simplified technique that consisted of stripping the Descemet's membrane and diseased endothelium from the recipient cornea, which was easier compared with performing lamellar dissections in both the donor and recipient eyes. Descemet's stripping with endothelial keratoplasty (DSEK) and Descemet's stripping with automated endothelial keratoplasty (DSAEK) (a motorised microkeratome (Moria, Antony, France) is used to prepare the donor lenticule) offer several advantages over PLK and DLEK as no complex stromal dissection is required and there is less surgical trauma to the anterior segment.

Although the visual and refractive outcomes with DSEK/DSAEK are very encouraging, donor lenticule dislocation in the early postoperative period is still common with this technique. Price *et al* reported a donor disc dislocation rate of 14% in his

first 200 cases.¹⁰ Though the exact aetiology for donor disc dislocations is not completely understood, several intraoperative techniques have been proposed to minimise this complication. Price proposed massaging the surface of the cornea and creating four mid-peripheral corneal incisions through the recipient cornea down to the graft interface, which serves as a conduit to drain the interface fluid while a large air bubble in the anterior chamber pushes the donor disc towards the recipient stroma.¹⁰ Terry suggested intraoperative roughening of the peripheral stromal bed to improve donor disc adherence (Federated Scientific Session meeting of the Cornea Society and Eye Bank Association of America, 15 October 2005, Chicago). We herein describe a slit-lamp technique of draining interface fluid with the aid of these drainage tracts that were prepared at the time of surgery, which we found to be effective in managing cases of complete donor dislocations following DSEK/DSAEK.

METHODS

Our hospital's institutional review boards approved a clinical protocol and investigational surgical consent form for DSEK/DSAEK surgery. We prospectively recruited patients with endothelial decompensation who consented to undergo DSEK/DSAEK procedure. From January 2006 to February 2007, 40 patients had undergone DSEK/DSAEK at our institution. Preoperatively, the medical history of each patient was recorded and a complete eye examination was performed including best-corrected visual acuity (BCVA), biomicroscopy, tonometry and a dilated fundus examination. Postoperatively, patients were seen at day one, one week, 1, 3 and 6 months and are further scheduled to be followed up at 1 year and 2 years.

The operation was performed by either of the authors. Intraoperatively, the following measures were taken to promote donor disc attachment:

Abbreviations: BCVA, best-corrected visual acuity; DLEK, deep lamellar endothelial keratoplasty; DSAEK, Descemet's stripping automated endothelial keratoplasty; DSEK, Descemet's stripping endothelial keratoplasty; OVD, ophthalmic viscosurgical device; PLK, posterior lamellar keratoplasty

Figure 1 Slit-lamp photograph of the left eye in case 2 showing complete donor disc dislocation with fluid along the entire length of the interface.

1. The donor corneal button in Optisol GS solution was removed from the icebox and maintained at room temperature for 30 min prior to the surgical procedure.
 2. Following Descemet’s stripping and before insertion of the donor disc, four mid-peripheral full thickness drainage slits were created using an MVR blade.
 3. Following the insertion and positioning of the donor disc, the anterior chamber was left completely filled with air for 10 min.
 4. During this time, a drop of OVD was placed on the recipient corneal surface to protect the epithelium and a curved typing forceps was used to firmly massage the corneal surface, starting from the centre towards the periphery to aid in drainage of the interface fluid into the anterior chamber.
 5. At the end of 10 min, balanced salt solution was used to decrease the size of the air bubble to approximately 9 mm and the patient was instructed to lie in a supine position for 24 h.
- We did not perform Terry’s intraoperative peripheral stromal roughening technique in this cohort. Five of the first 40 patients (12.5%) presented with disc dislocations on the first post-operative day. Slit-lamp biomicroscopy showed interface fluid between the recipient stoma and the donor disc, characterised by a clear space corresponding to the entire length of the slit beam (fig 1). The demographics of these patients are summarised in table 1.

Slit-lamp drainage technique

The entire procedure was performed in the office under slit-lamp biomicroscopy. Following informed consent, under aseptic condition a sterile lid speculum was placed to expose the operated eye. A 30-gauge needle mounted on a Luer lock 3 ml syringe pre-loaded with air was placed in the anterior chamber through the superior virgin posterior limbal tissue. About 0.1 ml of aqueous was released by gently depressing the posterior lip of the paracentesis, following which air was injected to completely fill the anterior chamber. Care was taken to place the tip of the needle in the anterior chamber. The limbal paracentesis created during the original operation was left untouched. At this stage, light perception was checked to ensure adequate retinal vascular perfusion. With the patient instructed to look straight ahead, a 0.12 Castroviejo-Colibri forceps was used to open the inferior mid-peripheral corneal drainage slit. The entire procedure was performed with the patient seated in the office chair, and under direct slit-lamp biomicroscopy. We were able to observe the drainage of the interface fluid, as the inferior corneal slit was held open with the 0.12 forceps.

This manoeuvre was sufficient to completely drain the interface fluid in all five patients, who presented with complete donor disc detachments on the first postoperative day (fig 2). Following this, the air was left in place for one hour and the patient placed in a reclining position. Examination an hour later confirmed complete adherence of the donor disc evidenced by the absence of the fluid space between the donor and the recipient tissue on biomicroscopy (fig 3). The donor discs were well centred in all cases. No complications were encountered with this procedure.

RESULTS

Five of the first 40 patients (12.5%) in our centre presented with complete donor disc dislocation on the first postoperative day. Of these, one (patient 1) underwent DSEK with manual dissection to prepare the donor disc, while the remaining four underwent DSAEK where a microkeratome (Moria, France) was used to prepare the donor lenticule. In all patients, air injection in the anterior chamber followed by opening the pre-existing inferior mid-peripheral corneal drainage slit under direct slit-lamp observation in the office was sufficient to completely drain the interface fluid, which led to successful reattachment of the donor lenticule in all cases.

DISCUSSION

In the Western world, endothelial dysfunction is one of the leading indications for corneal transplantation.^{13 14} and

Table 1 Demographics and visual outcome of patients presenting with complete donor disc dislocations

Patient	Age	Sex	Preoperative diagnosis	Preoperative BCVA	Procedure performed	BCVA at 1 week	BCVA at 1 month
1	80	M	PBK, PXF glaucoma	20/200	DSEK	20/100	20/80
2	82	F	Failed graft performed for FED	20/400	DSAEK	20/100	20/100
3	56	F	ICE syndrome	HM	DSAEK and phaco	20/100	20/40
4	60	M	FED and cataract	20/400	DSAEK and phaco	20/80	20/40
5	65	M	FED and cataract	20/300	DSAEK and phaco	20/100	20/40

BCVA, best-corrected visual acuity; DSEK/DSAEK, Descemet’s stripping with (automated) endothelial keratoplasty; FED, Fuch’s endothelial dystrophy; HM, hand movements; ICE, iridocorneal endothelial syndrome; PBK, pseudophakic bullous keratopathy; PXF, pseudoexfoliation.

Figure 2 Schematic illustration of the technique of the technique of draining interface fluid. (A) The presence of interface fluid between the donor and recipient tissue. Note the black slits within the donor cornea indicate the full thickness mid-peripheral drainage slits created during the operation. (B) Air bubble being injected into the anterior chamber through the virgin posterior limbal tissue. (C) Opening of the inferior corneal drainage slits helps in the drainage of the interface fluid. (D) Diagram illustrating reattachment of the donor disc.

penetrating keratoplasty has been the standard method for replacing the diseased endothelium for nearly 100 years.¹⁵ Despite tremendous advances in eye banking, surgical techniques and graft survival over the last 20 years,¹⁶ penetrating keratoplasty is a full-thickness procedure, replacing the entire cornea, when only the diseased endothelium needs replacement. Although full-thickness grafts provide excellent optical clarity, the inherent problems associated with full-thickness vertical wound healing, ocular surface problems and prolonged time for visual rehabilitation are well documented.^{17–20}

Selective endothelial replacement surgery offers several significant advantages over penetrating keratoplasty with regards to rapid recovery of postoperative vision,^{7–9} normal corneal topography,⁷ early refractive stabilisation^{9–11} and rapid wound healing.¹⁰ The two major problems currently encountered with selective endothelial replacement surgery is donor disc detachment (in the early postoperative period) and interface haze which can affect the long-term visual outcome.

Figure 3 Slit-lamp photograph of the left eye in case two shows complete reattachment of the donor disc. Note the residual air bubble in the anterior chamber.

To deal with the former problem, Melles prepared the donor disc to a slightly smaller size than the recipient bed in PLK.² Terry highlighted the importance of the position of the donor disc edge to the recipient edge and recommended tucking the edges of the donor disc anterior to the recipient bed edge to prevent postoperative dislodgement of the disc.⁸ In spite of this technique he experienced donor detachment rate of 6% in his first 90 cases (*Ophthalmology Times*, 15 May 2005) and 4% in his first 98 cases of DLEK surgery.²¹ In a recent publication Price reported a donor disc dislocation rate of 50% in the first 10 cases.¹⁰ Following this, he suggested a few modifications including massaging the cornea with a Lindstrom LASIK roller to milk the interface fluid, leaving a partial air bubble in the anterior chamber and instructing the patients to lie supine for up to one hour postoperatively. Both these manoeuvres markedly decreased the donor detachment rates to 13%. The introduction of multiple corneal mid-peripheral “drainage slits” further decreased the dislocation rate to 3%.¹⁰

Although the exact aetiology of donor disc dislocation is still unclear, it is possible that the texture of the donor and the recipient interface may have a role to play. A donor disc prepared using a microkeratome usually results in a smooth stromal surface on the donor disc, which may not adhere, as well as a donor disc prepared with manual dissection. In our own laboratory-based electron microscopy study (unpublished data) comparing manual, microkeratome and femtosecond laser for deep anterior lamellar keratoplasty, we found the stromal interface to be very smooth with both microkeratome and femtosecond laser when compared to manual dissection. Terry reported similar results in a histological study comparing donor disc dislocation in DLEK and DSEK surgery (Federated Scientific Session meeting of the Cornea Society and Eye Bank Association of America, 15 October 2005, Chicago) and proposed roughening up of the peripheral stroma in the recipient to create a “Velcro” effect which may improve the attachment of the donor disc. Recently Price *et al* reported a non-surgical technique of positioning the patient “face down” which helped in promoting donor disc adherence.²²

Our technique offers several advantages:

1. The slit-lamp biomicroscopy provides the best opportunity to visualise the extent and the amount of interface fluid. Once

these patients lie supine there is a risk that the donor disc can fall back to the iris, making the entire process of reattachment difficult.

2. The slit beam of the biomicroscope facilitates the depth perception and makes accidental contact with the disc less likely. Through slit-lamp observation the surgeon can be sure of the position of the needle in the anterior chamber as accidental injection of air in the interface can further dislodge and may even lead to inappropriate folding of the disc.

3. One can choose the place of entry with the 30-gauge needle.

4. The mid-peripheral inferior corneal slit created during surgery can be used to effectively drain the interface fluid. We found that the opening of the inferior mid-peripheral corneal slit causes gravity-aided drainage of interface fluid and with this technique one can directly watch the drainage of fluid through the inferior corneal slit through the slit-lamp.

5. With our technique drainage can be performed as soon as it is detected during office examination, without waiting for the operating or minor treatment room.

With more surgical experience and better understanding of the aetiopathogenesis of donor disc dislocation it should be possible to overcome this complication.

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